



## **Filing Receipt**

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4/8/2025

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Public Utility Commission of Texas  
1701 N. Congress Avenue  
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Austin, TX 78711-3326

**RE: Project No. 35077, Amendment One to ERCOT Standard Generation Interconnection Agreement between CenterPoint Energy Houston Electric, LLC and NRG Greens Bayou 6 LLC**

To whom it may concern:

Enclosed for filing in Project No. 35077 is the Amendment One to ERCOT Standard Generation Interconnection Agreement (SGIA) dated 5/1/2025 between CenterPoint Energy Houston Electric, LLC and NRG Greens Bayou 6 LLC. This filing is made pursuant to 16 Tex. Admin. Code § 25.195(e).

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Mickey Moon", written over a horizontal line.

Mickey Moon  
Assistant General Counsel  
CenterPoint Energy Houston Electric, LLC

Enclosures: (1) Executed SGIA

**AMENDMENT ONE TO  
ERCOT STANDARD GENERATION INTERCONNECTION AGREEMENT**

This Amendment One ("Amendment") to the ERCOT Standard Generation Interconnection Agreement, dated May 1, 2025 (the "SGIA"), is made between **NRG Greens Bayou 6 LLC** ("Generator") and **CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC** ("CenterPoint Energy"), (collectively, "the Parties") to be effective as of the date of the SGIA. In consideration of the mutual promises and undertakings herein set forth, Generator and CenterPoint Energy agree to amend the SGIA as follows:

The Parties hereby amend the SGIA by replacing Exhibits F, G, H, I and J of the SGIA with Exhibits F, G, H, I and J attached to this Amendment.

Except as otherwise expressly provided for herein, the SGIA will continue in full force and effect in accordance with its terms.

Generator and CenterPoint Energy have caused this Amendment to be executed in several counterparts, each of which shall be deemed to be an original, but all shall constitute one and the same instrument.

CenterPoint Energy Houston Electric, LLC

NRG Greens Bayou 6 LLC

By: Decubated by: Kevin Sarvis

By: Signed by: Thomas Atkins

Name: Kevin Sarvis

Name: Thomas Atkins

Title: Manager, Transmission Accounts and Support

Title: Vice President

Date: April 7, 2025

Date: April 1, 2025

**Exhibit "F"**

**Transmission and Substation Outage and Clearance Coordination Procedures**



# Transmission & Substation Outage and Clearance Coordination Procedures

Real Time Operations Department

Revised October 13, 2020



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## **CenterPoint Energy Telephone Numbers**

### **Real Time Operations Department (RTO)**

RTO System Controller	281-894-0491 (24 hours)
RTO HOTLINE (Emergency)	281-894-1625 (24 hours)

### **Outage Scheduling:**

Submit request to: [OutageRequest@centerpointenergy.com](mailto:OutageRequest@centerpointenergy.com)

Outage Questions call 713/207-2714 (Primary) or 713-207-2196

### **Metering Department:**

High Voltage Metering	713-945-6689
Metering Engineering	713-207-6287

### **Transmission Accounts Representatives:**

Nicholas Carroll	713-207-2785
Greg DonCarlos	713-207-3512
Reverteo McHaney	713-207-2263
Tim Raines	713-207-3538
Kevin Sarvis	713-207-5639





## **1. Introduction**

### **1.1. *Applicability***

This procedure applies to entities (the Customers) who own high voltage transmission and/or generation facilities interconnected to CenterPoint Energy Houston Electric, LLC's (CNP) 69kV, 138kV, or 345kV transmission system. Customer, as used in this document, includes the Customer's authorized contractors or agents. The Customer shall ensure that the provisions in this document are applied to facilities that may be owned by others and that are interconnected to the Customer's facility at the same voltage at which the Customer's facility is interconnected to CNP's transmission system.

### **1.2. *Purpose***

The purpose of this document is to facilitate the coordinated operation, outage coordination, maintenance, design, and modification of the Customer's high voltage transmission or generation facilities with CNP facilities.

### **1.3. *Copies of This Procedure***

The Customer shall keep copies of this procedure in applicable Customer substation control houses and plant operating centers. This procedure, including forms, may be reproduced.

### **1.4. *Facility Ownership or Name Change***

The Customer shall inform CNP of any change in ownership or name of their interconnected facilities or facilities owned by others that are interconnected to their facilities.

### **1.5. *Procedure Conflicts***

Any conflicts between this procedure and the Customer's procedures shall be thoroughly discussed with appropriate CNP representatives and resolved before beginning any work.

### **1.6. *Equipment Changes***

The Customer shall provide all equipment, in accordance with CNP specifications, whenever changes in CNP transmission system, including monitoring and protection devices, require changes in the Customer's interconnected facilities to maintain compatibility.

The Customer shall provide sufficient notice to CNP of any proposed changes to their facilities as specified in Section 9 (Equipment Additions, Replacement, Upgrades and Removal) of this document. This notification shall include providing necessary details, so that CNP can provide comments based upon a general, functional review. The Customer shall not procure any equipment or materials or begin any work until all CNP comments are incorporated or resolved.



### **1.7. Generation Installation and Operation**

Customers desiring to connect generation that will operate in parallel to CNP's transmission system shall file an application with the Electric Reliability Council of Texas (ERCOT) requesting interconnection in accordance with ERCOT's Generation Interconnection Procedure.

The Customer's generation facility shall be operated in accordance with the ERCOT Protocols and Operating Guides available at:

<http://www.ercot.com/mktrules/nprotocols>

<http://www.ercot.com/mktrules/guides/noperating/cur>

### **1.8. Power Factor**

The Customer shall provide suitable apparatus to maintain power factor consistent with the requirements of CNP's Tariff for Retail Delivery Service.

### **1.9. Voltage Fluctuations**

The Customer shall provide suitable apparatus to mitigate voltage fluctuations to reasonable limits should the Customer's equipment cause voltage fluctuations that interfere with CNP's transmission system.

### **1.10. Emergency Response**

In an emergency, the Customer shall switch substation equipment, reduce MW output, change reactive output, or perform other measures as directed by ERCOT or CNP's Real Time Operations Department (RTO), to help alleviate the emergency.

CNP may interrupt transmission service to and deliveries from the Customer in the event of an emergency.

### **1.11. Unplanned Outage Restoration**

Customer substations are an integral part of the interconnected transmission system, and CNP personnel may need to perform switching activities in a Customer substation to restore service to other customers in a timely manner. Customer actions that delay such switching activities can result in economic and/or environmental impacts for neighboring customers and pricing impacts for electricity market participants.

The Customer shall follow the applicable provisions as specified in Section 6 (Unplanned Outages) of this document.

Following evaluation of available information, the RTO System Controller shall issue switching orders to restore CNP transmission lines. Available information may include Customer reports, CNP field inspections of transmission lines and substations, lightning data, digital fault recorder data, protective relay data, fault location analysis, and Traveling Wave System ("TWS") fault location.



## **2. CNP Access to the Customer's Facilities**

### **2.1. *Authorized Representative of CNP***

An authorized representative of CNP shall have access to the Customer's premises for the purpose of performing switching orders, inspecting CNP's wiring and apparatus, repairing, erecting, removing, or replacing CNP-owned equipment, reading CNP meters, performing routine testing of certain Customer equipment, performing inspections of CNP apparatus and switching following an unplanned outage of CNP transmission lines, and for all other purposes related to the interconnection.

## **3. Communications with CNP**

### **3.1. *Operating Personnel Communications***

To reduce the possibility of miscommunication that could lead to action or inaction harmful to the reliability of the Bulk Electric System (BES) CNP shall require operating personnel that issue an oral two-party, person-to-person Operating Instruction to take one of the following actions:

- Confirm the receiver's response if the repeated information is correct.
- Reissue the Operating Instruction if the repeated information is incorrect or if requested by the receiver.
- Take an alternative action if a response is not received or if the Operating Instruction was not understood by the receiver.

CNP requires operating personnel that receive an oral two-party, person-to-person Operating Instruction to take one of the following actions:

- Repeat, not necessarily verbatim, the Operating Instruction and receive confirmation from the issuer that the response was correct.
- Request that the issuer reissue the Operating Instruction.

Operating Instruction definition: A command by operating personnel responsible for the Real-time operation of the interconnected Bulk Electric System to change or preserve the state, status, output, or input of an Element of the Bulk Electric System or Facility of the Bulk Electric System.

### **3.2. *Real Time Operations Department***

RTO operates CNP's transmission system and coordinates the operation of interconnected high voltage facilities. RTO provides routine and emergency switching instructions, issues clearances, and dispatches CNP personnel in response to electrical outages and problems. The Customer shall schedule planned outages with RTO and obtain from RTO switching instructions for any equipment at the Customer's substation that is directly interconnected with CNP's transmission system. Switching in the Customer's facilities that are remote to the Customer's substation directly interconnected with CNP's transmission system does not need to be scheduled. CNP will notify the Customer one or more days in advance if switching is required in the



Customer's substation for planned transmission line outages or if the Customer's substation will be placed in a single-ended condition.

### **3.3. *Scheduling Transmission Equipment Outages***

CNP's substation equipment outage scheduling and reporting requirements have been developed to support ERCOT requirements for scheduling outages on circuit breakers, bus sections, transmission lines, and transformers that have an operating voltage of 60kV and higher and to support requirements for scheduling outages of ERCOT Polled-Settlement (EPS) metering equipment.

The Customer shall contact the RTO Outage Scheduler as shown in Table 1 at the end of this section to coordinate outages in the substation that is directly interconnected with CNP's transmission system. Requests are considered in the order they are received.

**Switching Orders, Clearances** - The Customer shall follow switching instructions provided by the RTO System Controller prior to initiating any switching to remove equipment from service or return equipment to service in the Customer's facilities. The Customer shall request a clearance from the RTO System Controller when required. A "Switching Order" form and a "Transmission Switching Check List" form are included in this document. The RTO System Controller can be contacted at 281-894-0491.

**Unplanned Outages, Emergencies** - The Customer shall contact the RTO System Controller as soon as possible whenever any unplanned tripping of any circuit breaker operating at a voltage of 60 kV and higher occurs. An "Unplanned Outage Check List" form is included in this document. In the event of an unplanned generation outage, the Customer or his designated representative shall advise CNP's RTO System Controller as soon as possible. In emergency situations, switching may be performed by a qualified person, which is authorized by the Customer, based upon switching instructions provided by the RTO System Controller. An "Emergency Switching Check List" form is included in this document. The RTO System Controller can be contacted at 281-894-0491 or at the RTO HOTLINE 281-894-1625.

**ERCOT Approvals** - The RTO System Scheduler will coordinate a review and notify the Customer whether the outage can be scheduled for the desired day. Transmission line outages and the energization of new equipment require the approval of ERCOT. The Customer shall notify the RTO System Scheduler as soon as possible if an outage is canceled prior to the outage date. The Customer shall immediately notify the RTO System Controller if an outage is canceled on the day of the outage. CNP endeavors to notify the Customer as soon as possible when it is deemed necessary to cancel an outage.

**Customer Substation Evacuations** – During emergencies requiring evacuation of the Customer's facility, the Customer shall contact RTO prior to the evacuation and provide information regarding the operational status of their substation and associated support facilities, such as substation station service power, battery and battery charger, and ability for CNP to access the substation. The Customer's



substation is an integral part of the interconnected transmission system and disabling them has an impact on the electrical grid.

### ***3.4. Transmission Accounts Division***

CNP's Transmission Accounts Division ("Transmission Accounts") is responsible for coordinating the Customer's service needs within CNP. Transmission Accounts representatives endeavor to inform the Customer of long range planned switching and projects that may affect the Customer's facility.

The Customer shall notify the Transmission Accounts representative as specified in Section 9 (Equipment Additions, Replacement, Upgrades and Removal) when equipment additions or removals are planned or when high voltage equipment 60 kV and higher or associated equipment requires modification or replacement. The Customer shall contact a Transmission Accounts representative to request current CNP specifications and applicable bills of material for substation equipment additions and replacement.

Transmission Accounts representatives may be contacted for any questions concerning the operation of the Customer's substation. The Transmission Accounts representatives are listed on the CenterPoint Energy Telephone Numbers page in this document.

### ***3.5. Substation and Equipment Identification***

CNP assigns a substation name, or a Substation ID of three characters, to identify the Customer's substation facility. The Substation ID is also referred to as the three-character mnemonic. CNP mounts signs with the substation name or the Substation ID on a substation control house door and on a substation entrance gate at the Customer's facility.

The Customer's high voltage circuit breakers switches, transformers, and certain low side equipment shall be identified with CNP's assigned numbers. CNP develops a substation basic one-line diagram that includes these assigned numbers. CNP or the Customer shall mark these numbers on the substation equipment. CNP may stencil identification numbers on substation equipment and mount signs, labels, drawings, telephone numbers, and instructions on the Customer's facilities.

The Customer shall use CNP's assigned substation name, or Substation ID, and equipment identification numbers in discussions with the RTO System Controller and the RTO System Scheduler.

### ***3.6. Telephone Lines and Data Communication***

The customer is responsible for arrangements with the telephone service provider to establish a direct dial telephone land line to the customer substation control cubicle.



Refer to CenterPoint Energy 007-400-02 Specification for Remote Telemetry of a Customer-Owned Facility for details pertaining to required communications circuits (i.e., customer provided voice communication and CenterPoint Energy provided telemetry communications for SCADA, metering, etc.)

### **3.7. Alarm Response**

CNP responds to alarms for communication equipment installed to protect CNP transmission circuits.

The Customer shall report substation alarms to the RTO System Controller and respond to alarms pertaining to their equipment. A protective relay "CPU Failure" alarm shall be immediately reported to the RTO System Controller. A "Loss of DC" alarm shall be immediately reported to the RTO System Controller and investigated by the customer



### 3.8. Outage Scheduling Requirements

Per ERCOT and CNP outage reporting requirements: planned outages on circuit breakers, transmission lines, and autotransformers that are rated 60 kV and higher must be submitted to the ERCOT Outage Coordinator by the CNP RTO Outage Coordinator.

Per ERCOT Protocols, planned outages on ERCOT Polled Settlement (“EPS”) meters and the equipment to which they are connected require a 5 day minimum notice. A 10 calendar-day minimum notice is required for any modifications to approved EPS equipment.

**Table 1 Planned Outage Scheduling**

Equipment Being Requested	Minimum Advance Notice	Contact
69 kV and 138 kV lines, single load transformers, individual breakers and bus outages of no more than one day in duration.	No later than 1200 hours Wednesday two weeks before the Planned Outage is to take place.	Outage Scheduler @ 713-207-2196 or 713-207-2714
All transmission line outages and equipment outages, including busses, of up to four contiguous days duration (daily or continuous outages).	35 Calendar Days	Outage Scheduler @ 713-207-2196 or 713-207-2714
Any transmission line outages and/or equipment outages, including busses, of 5 days or longer duration (daily or continuous)	90 Calendar Days	Outage Scheduler @ 713-207-2196 or 713-207-2714

Amount of time between the request for approval of the proposed Outage and the scheduled start date of the proposed Outage:	ERCOT shall approve or reject no later than:
Three days	1800 hours, two days before the start of the proposed Outage
Between four and eight days	1800 hours, three days before the start of the proposed Outage
Between nine days and 45 days	Four days before the start of the proposed Outage
Between 46 and 90 days	30 days before the start of the proposed Outage
Greater than 90 days	75 days before the start of the proposed Outage



### **3.9. Cyber Security Incident**

A Cyber Security Incident is a malicious act or suspicious event that disrupts, or was an attempt to disrupt, the operation of a Bulk Electric System (BES) Cyber System. A SCADA remote terminal unit (RTU) is an example of a BES Cyber System.

If the Customer identifies a possible, or verified, Cyber Security Incident impacting the operation of a CNP-owned BES Cyber System, the Customer shall contact RTO as soon as practicable.

## **4. Switching, Clearances, Grounding**

### **4.1. Billable Costs**

Grounding and switching requested by the Customer to be performed during other than normal working hours is billable to the Customer.

Grounding and switching charges will be waived under the following conditions:

- The Customer requesting switching or grounding activities by CNP is a transmission voltage service customer that is interconnected to CNP's transmission system through a customer-owned substation; and
- The requested activities are to allow the Customer to perform maintenance activities or equipment upgrades on its transmission voltage facilities within the Customer's substation; and
- The switching and grounding field activities are requested to occur on a normal CNP work day, with outages commencing no earlier than 0800, and outages concluding no later than 1600.

Outages extending beyond the timeframes identified in Section 4.1.2.3 above (commencing no earlier than 0800 and concluding no later than 1600) on a forced basis may result in billing for associated switching and grounding activities, as determined on a case-by-case basis.

Outages with switching or grounding activities requested for more than two consecutive days may be subject to charges for each additional consecutive day, even if the outages occur within the timeframes identified in Section 4.1.2.3 above (commencing no earlier than 0800 and concluding no later than 1600), unless early or intermittent outage restoration is required by ERCOT or for CNP system requirements.

Questions regarding charges should be directed to the Transmission Accounts representative.





## **4.2. Switching**

CNP performs necessary switching at the remote end of a CNP transmission line for outages at the Customer's substation that require switching of CNP transmission lines. CNP provides switching instructions for the high voltage devices in the Customer's substation that is directly interconnected with CNP's transmission system. Switching instructions are not provided for remote facilities interconnected to the Customer's substation that is directly interconnected with CNP's transmission system. A "Switching Order" form and a "Transmission Switching Check List" form are included in this document.

The Customer shall follow switching instructions provided by the RTO System Controller prior to initiating any switching to remove equipment from service or return equipment to service in the Customer's facilities. The Customer shall implement specific procedures for the switching of its facilities. These procedures shall include a visual check that all phases have fully opened or closed. A device bearing a Hold Tag shall not be operated under any circumstances.

The Customer shall provide a Hold Order to RTO for switching at generation facilities for equipment that interconnects with CNP.

## **4.3. Clearances**

A clearance is required for applicable work on high voltage apparatus connected to CNP transmission lines when switching at the remote end of a CNP transmission line is necessary. Clearances are also issued when the Customer and CNP will be working on apparatus within the same isolated area at the Customer's facilities. Each party will be issued an individual clearance.

A clearance is required for applicable work on high voltage apparatus connected to CNP transmission lines when switching at the remote end of a CNP transmission line is necessary. Clearances are also issued when the Customer and CNP will be working on apparatus within the same isolated area at the Customer's facilities. Each party will be issued an individual clearance.

The Customer shall request a clearance from the RTO System Controller when required. Personnel authorized by CNP will perform either "trip & hold" or "check for trip & hold" on necessary devices before a clearance will be issued.

A clearance cannot be released by anyone other than the person to whom it was issued unless uncontrollable circumstances make that impossible. In this situation, the person's supervisor may, after informing each member of the crew that such action is being taken, contact the RTO System Controller to release the clearance. For field personnel shift changes, the person assuming the leadership of the work will be issued a new clearance and the person to whom the clearance was originally issued<sub>3</sub> will then release the clearance.



#### **4.4. Grounding**

CNP issues clearances, as identified in Section 4.3.1 above, indicating that high voltage devices have been opened, locked, and tagged to prevent the devices from operating. After receiving a clearance from the RTO System Controller, if required, and verifying that the apparatus is de-energized, the Customer shall install protective grounds on all de-energized electrical apparatus before applicable work is performed on it. The Customer shall not install protective grounds on CNP transmission lines or CNP equipment.

When more than one party (e.g., the Customer and CNP) will be working on apparatus within the same isolated area at the Customer's facilities, each party shall install their own individual grounds before applicable work is performed.

The Customer may perform work on the control circuits and mechanisms of a device without grounding the apparatus, if such work can be performed without risk of contact with primary voltages. Grounds may be temporarily removed if required by testing procedures.

Before a grounding device is attached to any Customer high voltage bus work, the Customer shall first test the bus work to confirm that it is de-energized. Grounds shall be placed such that the operation of a switching device cannot remove their protection.

The clamps and conductors of grounding devices used by the Customer shall be designed for the available fault current. Grounding devices shall be inspected for broken strands and loose connections. The surface of the ground clamps shall be clean of corrosion and oxides.

Grounding devices used by the Customer for high voltage bus work shall be installed and removed with the use of applicable live line tools. Grounding devices shall be securely connected at the ground end before connection is made to the Customer high voltage bus work. Grounds shall be removed by first detaching the connection at the conductor and, then, detaching the connection at the ground end. When grounding to a steel structure, the ground shall not be applied to a flat surface unless an appropriate flat surface clamp is used.

CNP does not ground Customer-owned substation equipment except for work being performed by CNP.

#### **4.5. Switching 345 kV Facilities Equipped with Ferroresonance Protection**

Ferroresonance protection is installed whenever a wound potential transformer (PT) is connected to 345 kV and the possibility of a ferroresonance condition occurring exists. If applicable, the Customer shall implement specific procedures for switching 345 kV equipment that has ferroresonance protection installed.

Procedures shall include the following:



1. Place the sync handle in position for the last breaker that will be opened.
2. Monitor the three potential lights located on the control panel inside the control house before and after the last breaker is opened.
  - a. If one or more of the lights do not dim immediately but gets brighter immediately close the last breaker opened to reenergize the bus and investigate the ferroresonance protection
  - b. If all lights dim immediately reset the targets (flags) on the ferroresonance protection relays
  - c. If relay targets did not operate investigate the ferroresonance protection circuit

#### **4.6. Terminology for Switching Orders**

**Time** - Military time, or 24-hour clock, based on prevailing Central Time.

**Check Ring for Close** - Verify by visual inspection that all devices in the ring are in the closed position.

**Remove / Roll Loads** - Remove all loads connected to a power transformer. This may be done by tripping applicable low side breakers or by rolling load to an adjacent transformer and tripping applicable low side breakers.

**Trip** - Initiate and complete an opening operation on a device.

**Close** - Initiate and complete a closing operation on a device.

**Hold Tag** - A tag placed on a device to indicate the equipment shall not be allowed to change operating state. The tag shall indicate the party who placed the tag.

**Trip and Hold** - Trip device, physically or mechanically (e.g., affix padlock) disable device from closing, and place a Hold Tag on the device.

**Check for Trip and Hold** - Verify by visual inspection that a device is in the trip position and place a Hold Tag on the device.

**Secure Against Operation (SAO)** - Physically, mechanically, or electrically disable a device (e.g., a motor operated disconnect switch) to prevent it from operating.

**Secondary Potential Fuse (SPF)** - Remove and tag fuses on the secondary side of potential devices to prevent the possibility of back energizing isolated equipment.



#### 4.7. Switching Order

## SWITCHING

**ORDER #** \_\_\_\_\_

SUBSTATION \_\_\_\_\_

EQUIPMENT \_\_\_\_\_

OUT                      RESTORE

DISP \_\_\_\_\_ DISP \_\_\_\_\_

TIME \_\_\_\_\_ TIME \_\_\_\_\_

DATE\_\_\_\_\_ DATE \_\_\_\_\_

EXEC. BY \_\_\_\_\_ EXEC. BY \_\_\_\_\_

TIME \_\_\_\_\_ TIME \_\_\_\_\_

**CLEARANCE #** \_\_\_\_\_

**ISSUED**

RELEASED

DISP. \_\_\_\_\_ DISP. \_\_\_\_\_

TIME \_\_\_\_\_ TIME \_\_\_\_\_

DATE \_\_\_\_\_ DATE \_\_\_\_\_

ISSUED TO \_\_\_\_\_

NUMBER OF MEN \_\_\_\_\_ AND GROUNDS \_\_\_\_\_

ON \_\_\_\_\_

## INSTRUCTIONS

[illegible]

SWITCHING PROCEDURES DISCUSSED  
WITH ALL MEMBERS OF CREW:

CREW INITIALS



#### 4.8. Transmission Switching Check List

The following basic procedures are for the day of the switching after the outage has been scheduled with and authorized by the RTO System Scheduler (713-207-2196). This applies to the Customer's substation that is directly interconnected with CNP's transmission system.

- ☐ Call the RTO System Controller at 281-894-0491 and request a Switching Order
  - ☐ Provide name, company affiliation, and telephone number
  - ☐ Provide Substation ID
  - ☐ Describe reason for request
  - ☐ Fill out Switching Order
    - ☐ Record the Switching Order number
    - ☐ Record start time provided by the RTO System Controller
    - ☐ Record the RTO System Controller's name
    - ☐ Record the instructions to take equipment OUT
    - ☐ Repeat the instructions
- ☐ Execute the Switching Order placing Hold Tags where appropriate
- ☐ Call the RTO System Controller when the instructions have been completed
  - ☐ Report the actual completion time
  - ☐ Record the completion time provided by the RTO System Controller on Switching Order
  - ☐ Request a Clearance if necessary
    - ☐ Provide the number of personnel in the crew
    - ☐ Provide the number of and location of grounds
- ☐ Verify apparatus is de-energized with a hot line indicator
- ☐ Install protective grounds when required
- ☐ Perform work
- ☐ Remove protective grounds if installed
- ☐ Call the RTO System Controller to request to RESTORE equipment
  - ☐ Report whether more than one Hold Tag is on any device
  - ☐ Provide Clearance number if applicable
    - ☐ Provide the number of personnel in the crew clear of the apparatus
    - ☐ Provide the number of grounds removed
  - ☐ Provide the Switching Order number
  - ☐ Fill out Switching Order
    - ☐ Record start time provided by the RTO System Controller
    - ☐ Record the RTO System Controller's name
    - ☐ Discuss performing Switching Order instructions in reverse order
- ☐ Alert all personnel to move to a safe distance from apparatus being energized
- ☐ Execute the Switching Order removing Hold Tags where appropriate
- ☐ Call the RTO System Controller when restoration has been completed
  - ☐ Report the actual completion time
  - ☐ Record the completion time provided by the RTO System Controller on Switching Order



## 5. Outage Scheduling Check List

### 5.1. Outage Scheduling Check List

The following instructions are for scheduling transmission equipment outages.

This applies to the Customer's substation that is directly interconnected with CNP's transmission system. Please refer to the "Outage Scheduling Requirements" outlined in Section 3 (Communications with CNP) of these procedures.

- ☐ Submit the following form to [OutageRequest@centerpointenergy.com](mailto:OutageRequest@centerpointenergy.com)
- ☐ Call 713-207-2714 (Primary) or 713-207-2196 for outage questions.
- ☐ Provide the following information:

[illegible]

Please make a courtesy phone call if a revision has changed the original submittal. CNP will contact the "Requestor" if additional data is required.



## 6. Unplanned Outages

### 6.1. Unplanned Outages

ERCOT Protocols require that CNP notify ERCOT of all unplanned transmission outages.

The Customer shall contact the RTO System Controller as soon as possible whenever any unplanned tripping of any high voltage (60 kV and higher) circuit breaker occurs. CNP crews will be dispatched when high voltage circuit breakers remain open in the Customer's substation that is directly interconnected with CNP's transmission system. CNP crews will reset relay targets except in emergency situations. An "Unplanned Outage Check List" form is included in this procedure.

CNP crews are not dispatched when high voltage circuit breakers remain open in a remote, non-CNP substation connected to the Customer's substation, but not directly interconnected with the CNP system. In such a case, the Customer shall discuss and evaluate the event with the RTO System Controller. The Customer shall notify the RTO System Controller prior to any switching.

In the event of an unplanned generation outage, the Customer or his designated representative shall advise CNP's RTO System Controller as soon as possible.

### 6.2. Unplanned Outages of 345 kV Facilities Equipped with Ferroresonance Protection

Ferroresonance protection is installed whenever a wound PT is connected to a 345 kV and the possibility of a ferroresonance condition occurring exists. If applicable, the Customer shall implement specific procedures for unplanned tripping of 345 kV equipment that has ferroresonance protection installed. Procedures shall include the following:

- Visually inspect the three potential lights located on the control panel inside the control house
  - If one or more of the lights are bright and not dim
    - Open all the breaker disconnect switches to isolate the potential transformers
    - Disconnect/Remove the PTs from service on the phases with the bright lights
  - If one or more of the lights are dark and not dim
    - Open all the breaker disconnect switches along the affected bus
    - Disconnect/Remove the PTs from service on the phases with the dark lights
  - If remote monitoring of potential transformer voltages indicated a ferroresonance condition occurred
    - Open all the breaker disconnect switches to isolate the potential transformers
    - Disconnect/Remove the PTs from service on the phases that indicated ferroresonance
  - If all lights are dim
    - Reset the targets on the ferroresonance protection relays
  - If relay targets do not indicate proper action
    - Investigate the ferroresonance protection circuit



### 6.3. Emergency Switching

In emergency situations, switching may be performed prior to a CNP crew arriving at the Customer's substation. A qualified person, authorized by the Customer, may operate breakers and switches based upon switching instructions provided by the RTO System Controller. Prior to switching, all relay trip targets shall be reset after the Customer has recorded them and reported them to the RTO System Controller. All personnel shall move to a safe distance from apparatus being energized prior to switching. An "Emergency Switching Check List" form is included in this procedure.

The following instructions are for whenever an unplanned tripping of a transmission service voltage breaker occurs.

#### UNPLANNED OUTAGE CHECK LIST

- ☐ Call the RTO System Controller at 281-894-0491
- ☐ Provide the following information to the RTO System Controller
  - ☐ Your name, company affiliation, and telephone number
  - ☐ Substation ID
  - ☐ Nature of the problem
  - ☐ Time of outage
  - ☐ Status of all breakers and switches (i.e., open, closed, tagged)
  - ☐ Cause of the event if known
  - ☐ Fault location and faulted equipment if known
  - ☐ Fires and their proximity to energized equipment
  - ☐ Plant and substation entry constraints (e.g., chemical releases)
- ☐ Record the RTO System Controller's name
- ☐ Investigate and provide the following information to the RTO System Controller
  - ☐ Cause of the event if found during investigation
  - ☐ Fault location and faulted equipment if found during investigation
  - ☐ Number of trip operations for each breaker (i.e., change in breaker veeder reading)
  - ☐ Relay trip and alarm targets - Do not reset targets
- ☐ Discuss outage with CNP crews
- ☐ CNP crews record and reset relay trip targets
- ☐ CNP crews record breaker veeder readings
- ☐ Resolve outage and complete any necessary corrective action
  - ☐ Call the RTO System Controller at 281-894-0491 to request to RESTORE equipment
  - ☐ Record the instructions to RESTORE equipment
  - ☐ Repeat the instructions
- ☐ Execute the instructions
- ☐ Call the RTO System Controller when instructions have been completed

BY: \_\_\_\_\_ DATE: \_\_\_\_\_





#### 6.4. EMERGENCY SWITCHING CHECK LIST

The following basic procedures are for emergency situations. Contact the RTO System Controller at one of the following telephone numbers.

- ☐ Call the RTO System Controller HOTLINE at 281-894-1625
- ☐ Provide the following information to the RTO System Controller
  - ☐ Your name, company affiliation, and telephone number
  - ☐ Substation ID ☐ Nature of the problem
  - ☐ Time of outage
  - ☐ Status of all breakers and switches (i.e., open, closed, tagged)
  - ☐ Cause of the event if known
  - ☐ Fault location and faulted equipment if known
  - ☐ Fires and their proximity to energized equipment
  - ☐ Plant and substation entry constraints (e.g., chemical releases)
  - ☐ Relay trip and alarm targets
- ☐ Record the RTO System Controller's name
- ☐ Record the instructions to RESTORE equipment
- ☐ Reset relay trip targets
- ☐ Execute the instructions
- ☐ Call the RTO System Controller at 281-894-0491 when instructions have been completed

BY: \_\_\_\_\_ DATE: \_\_\_\_\_.



### **6.5. Other Emergency Conditions**

Customer substations are an integral part of the interconnected transmission system and disabling them has an impact on the electrical grid. In certain emergency situations, the Customer may evacuate or shut down their facility. In such cases, the Customer shall endeavor to keep the portion of their substation that is directly connected to the transmission grid in service, unless specifically directed otherwise by the RTO System Controller or ERCOT. The Customer shall not disable A/C power to the DC battery system charger or any protection system components, unless specifically directed otherwise by the RTO System Controller.

## **7. Generation Operation**

### **7.1. Applicability**

This section applies only if the Customer operates electric generating facilities and participates in the wholesale transmission market. The Customer shall follow the ERCOT Operating Guides and ERCOT Protocols or other regulatory requirements that apply to their facilities.

### **7.2. Unit Operation**

Where CNP owns the interconnecting substation and there is not an in-line breaker to synchronize a generating unit, the Customer has control of CNP's substation breakers that are functioning as generator breakers. CNP has operational control of the disconnect switches associated with these breakers.

The Customer shall always have generation control personnel on duty at the generating unit site that the generating units are on-line.

The Customer or Customer's representative shall notify the RTO System Controller (281-894-0491) immediately before a unit is synchronized and connected to CNP's transmission system.

The Customer shall operate units to support the transmission system voltage by regulating reactive power output up to levels demonstrated in the ERCOT tests as required in the ERCOT Protocols. The Customer shall maintain the ERCOT specified voltage level unless otherwise directed by the RTO System Dispatcher or ERCOT.

The Customer's voltage regulators, speed governors, and power system stabilizers, if required by ERCOT, shall be in service whenever generating units are on-line. The Customer shall immediately notify ERCOT whenever a voltage regulator, speed governor, or power system stabilizer is taken out of service or placed back in service. The Customer shall maintain settings as close as practical to five percent speed regulation.

The Customer shall maintain generating units on-line during system frequency and voltage excursions per ERCOT Operating Guides:  
[www.ercot.com/mktrules/guides/noperating/cur](http://www.ercot.com/mktrules/guides/noperating/cur).



## 8. Protective Relaying and Control

### **8.1. *Settings for Relays Installed for the Protection and Automatic Reclosing of CNP Transmission Lines***

CNP calculates and implements all settings for the Customer's relays installed for the protection and automatic reclosing of CNP transmission lines and for the Customer's relays installed to prevent back-energizing CNP's system from generation installed on the low side of the Customer's power transformers. On a case-by-case basis, CNP may issue settings for other relays owned by the Customer. The relay settings implemented by CNP for the Customer's relays will be provided to the Customer upon request.

### **8.2. *Applicable Relay Settings***

The Customer shall provide CNP with the settings of the Customer's relays that trip or close the Customer's high voltage (60 kV and higher) circuit breakers. The Customer shall provide to the Transmission Accounts representative any proposed settings changes for such relays for CNP's review.

### **8.3. *Communications Connections to Electronic Devices***

An electronic device that can directly or indirectly trip a circuit breaker connected to a CenterPoint Energy transmission circuit (i.e., transmission line protective relay, transformer bus protective relay, local breaker failure relay, etc.) is not allowed to be monitored via routable protocol communication (i.e., Ethernet), serial or dial-up communication by customers connection directly to the device. Data from these electronic devices can be provided to the customer via the CenterPoint Energy SCADA RTU (CenterPoint Energy 007-400-02 Specification for Remote Telemetry of a Customer-Owned Facility) or the customer may install separate devices for monitoring purposes.

### **8.4. *Maintaining Levels of Protection***

The Customer shall not disable a single level, or multiple levels, of protection that results in no protection for an energized element, such as, a transmission line, high voltage bus, or transformer.

The Customer shall immediately notify the RTO System Controller whenever the Customer becomes aware of an energized element that has no protection.

The Customer shall immediately notify the RTO System Controller of a protective relay "CPU Failure" alarm or when a protective relay is found powered down, or out of service.



## **9. Equipment Additions, Replacement, Upgrades and Removal**

### **9.1. *Equipment Changes***

The Customer shall notify the Transmission Accounts representative with sufficient notice to meet the timeline and data reporting requirements in Table 2 below when equipment additions or removals are planned or when high voltage equipment or associated equipment requires modification or replacement. The Customer shall notify the Transmission Accounts representative prior to performing functional testing and allow CNP to witness the testing.

The Customer shall provide equipment and installation, including testing and inspections, per applicable CNP specifications and bill of materials. The Customer shall provide necessary details, such as drawings, specifications, and manufacturer type and catalog number, for CNP's review. All CNP comments shall be incorporated or resolved before any equipment or materials are procured or any work is begun.

ERCOT Protocols require that all changes to equipment rated at 60 kV and above be communicated by CNP to ERCOT prior to the in-service date as specified in Table 2 below.

ERCOT only approves energization requests when the transmission element is satisfactorily modeled in the ERCOT Network Operations Model.

### **9.2. *Modification, Repair, and Replacement of Customer Equipment***

CNP notifies the Customer of problems in their facilities of which CNP becomes aware. The Customer shall provide any needed equipment modifications, repairs, or replacement as soon as practicable. The Customer shall replace equipment that CNP demonstrates is no longer maintainable. On a case-by-case basis, the Customer and CNP shall develop the responsibilities for the modification, repair, and replacement of this equipment.

Industry experience may dictate that certain equipment be modified, repaired, or replaced due to manufacturing defects or unacceptable failure rates and consequences. The Customer shall, as soon as practicable, modify, repair, or replace equipment based on product service advisories issued by manufacturers or advisories issued by CNP.



### 9.3. Customer Substation Equipment Additions, Relocations, Upgrades and/or Removal

When installing, relocating, or upgrading transmission system equipment, Customers must contact their appropriate CNP Transmission Accounts representative with sufficient notice to meet the timelines and data requirements shown below. ERCOT Nodal Protocols Section 3.10.1 requires that all changes to transmission equipment energized at 60 kV and above be communicated by CNP to ERCOT using the Network Operations Model Change Request ("NOMCR") process as summarized below:

**Table 2**

Target Physical Equipment In-Service Month	Deadline to Submit to RTO	Timeline to Submit initial information to Transmission Accounts Rep
Month of January	Sept. 1	June 1 (prior year)
Month of February	Oct. 1	July 1 (prior year)
Month of March	Nov. 1	August 1 (prior year)
Month of April	Dec. 1	September 1 (prior year)
Month of May	Jan. 1	October 1 (prior year)
Month of June	Feb. 1	November 1 (prior year)
Month of July	Mar. 1	December 1 (prior year)
Month of August	Apr. 1	January 1
Month of September	May 1	February 1
Month of October	June 1	March 1
Month of November	July 1	April 1
Month of December	Aug. 1	May 1

(1) Pursuant to the ERCOT Nodal Protocols, CNP requires the following information to meet the deadlines shown above. The NOMCR data requirements include, but are not limited to:

- Completed project expected in-service date
- Equipment ratings
- Device nomenclature will be provided by CNP
- Engineering drawings showing the final configuration.
- Construction sequence with expected energization dates for each piece of equipment.
- Identification of SCADA data points
- Additional data as may be determined by ERCOT

(2) Known outage requests shall be submitted by Real Time Operations with the NOMCR's for each expected energization date.

(3) ERCOT only approves energization requests when the Transmission Element is satisfactorily modeled in the ERCOT Network Operations Model.



## **10. Equipment Maintenance and Testing**

### **10.1. *CNP Testing***

CNP will perform periodic testing of certain Customer-owned equipment if the equipment is installed for the protection of CNP transmission lines. This includes power line carrier tuning and testing of wave traps, tuners, and carrier sets and calibration and testing of relays and fiber optic communication equipment. CNP will perform testing of SCADA transducers that provide real time data to CNP. CNP may designate additional equipment of the Customer for testing by CNP. CNP will label equipment tested by CNP. The test results for the Customer's equipment tested by CNP will be provided to the Customer upon request.

CNP will endeavor to coordinate CNP testing with the Customer's maintenance outages.

CNP transmission line outages are required for CNP to perform testing of applicable wave traps of the Customer.

Outages of approximately ten hours duration for certain Customer facilities are required for CNP's periodic testing of CNP-owned high voltage metering instrument transformers. Transformer outages are required for metering instrument transformers installed on the high side of transformers. A total separation from CNP's system may be required for certain substation configurations.

### **10.2. *Customer Maintenance and Testing***

The Customer shall perform maintenance on all structures and equipment owned by the Customer. The Customer shall perform testing on all equipment owned by the Customer except for equipment designated by CNP for testing by CNP as noted in Section 10.1 (CNP Testing). The Customer shall maintain equipment logs and test reports, which shall be provided to CNP upon request.

Depending upon ownership, equipment maintained and tested by the Customer may include the following: line surge arresters, potential and current transformers, coupling capacitors, coupling capacitor potential devices, switches (including auxiliary contacts and motors if installed), breakers (bushings, mechanism, tanks), transformers (bushings, surge arresters, main tank, load tap changer, alarms), relays not tested by CNP, and DC battery system equipment.

The Customer shall notify the RTO System Scheduler at least ten (10) business days in advance before performing maintenance and testing on potential or current transformers connected to CNP meters.

### **10.3. *Monthly Inspections***

The Customer shall perform monthly inspections to include the following as applicable.

- Visual inspection of outdoor equipment including inside control cabinets



- Verify oil levels
- Verify transformer nitrogen blanket pressure
- Verify transformer fan operation
- Verify breaker compressor or hydraulic pump operation
- Drain condensate from breaker mechanism air tanks
- Verify operation of control house heating and air conditioning

#### **10.4. Quarterly, Semi-annual Testing, and Inspection**

CNP recommends Total Combustible Gas (TCG) testing once every three months on transformers equipped with a nitrogen blanket.

Infrared thermography of high voltage equipment is recommended once every six months.

#### **10.5. DC Battery System**

The Customer shall perform periodic DC battery system equipment inspections and maintenance to include the following as applicable.

##### **Every Month**

- Visually inspect batteries (corroded connections, leaks, cracked cases)
- Visually inspect chargers
- Verify and correct water levels
- Record and verify float voltage
- Record and verify ground reference voltage

##### **Every Six Months**

- Clean battery surfaces
- Check charger ventilation
- Record and verify cell voltages
- Perform internal cell resistance testing
- Measure inter-cell connection resistance
- Record and verify specific gravity reading
- Verify float and equalize voltage settings
- Verify proper operation of chargers and alarms
- Verify proper operation of high voltage shutdown circuits

#### **10.6. Functional Testing**

The Customer shall perform functional trip testing of each high voltage circuit breaker by tripping and closing the breaker from the breaker control switch at least once every year. This breaker tripping may be coordinated with the switching required for maintenance outages.

High voltage circuit breakers equipped with dual trip coils that use a common actuating shaft (e.g., Allis Chalmers, Westinghouse) require special functional testing. The Customer shall perform a test on each breaker by applying trip voltage simultaneously to both trip coils. If the breaker does not immediately trip, the voltage must be quickly removed to avoid damaging the coils. After verifying the wiring, the Customer shall appropriately label the control wiring. The Customer's maintenance procedures shall include tagging and properly



reconnecting trip coil wiring. The Customer shall perform this test whenever a trip coil is replaced, or breaker control wiring is modified.

### ***10.7. Special Inspection and Testing***

Industry experience may dictate that certain equipment requires special inspection and testing due to manufacturing defects or unacceptable failure rates and consequences. The Customer shall perform special inspection and testing based on product service advisories issued by manufacturers and advisories issued by CNP.

## **11. Plant Design Considerations**

### ***11.1. Emergency Systems***

Continuous electric service from utility power systems cannot be guaranteed even for facilities that are connected to a large number of transmission lines. The possibility exists that a total power outage or separation from the utility system may occur. It is important to consider this when plant emergency systems are designed.

### ***11.2. Automatic Reclosing***

CNP utilizes automatic reclosing of high voltage circuit breakers following unplanned tripping of CNP transmission lines. CNP endeavors to intentionally delay the initial reclose attempt by at least one second. The Customer is responsible for the separation of necessary motors or other equipment within one second of the tripping.

### ***11.3. System Voltage***

Electric service from a utility power system cannot be guaranteed against fluctuations. Voltage sag is a common fluctuation that occurs during the time of a fault. The large majority of faults on a utility transmission system are single line-to-ground faults. With automatic reclosing of circuit breakers, several voltage sags can occur within a one-minute period. Most voltage sags from faults on transmission systems have a very short duration of less than ten cycles with high-speed fault clearing. Another common fluctuation is a transient voltage oscillation that occurs each time a capacitor bank is energized. Equipment, such as motor contractors, adjustable speed drives, programmable logic controllers, and high intensity discharge lamps, can be sensitive to these short duration voltage sags and transient voltage oscillations.

11.3.2 It is important to consider voltage sag "ride-through" for equipment applied to critical processes where nuisance tripping can cause a whole process to shut down. Plant power systems and equipment control systems can be designed or modified to ride-through the most common voltage sags and transient voltage oscillations on utility power systems. CNP will provide additional information upon request.





#### ***11.4. Electrical Protection Coordination Studies***

If the Customer performs plant electrical protection coordination studies, the Customer may contact a Transmission Accounts representative to request the available CNP system fault current and system impedance at the Customer's facility.

#### ***11.5. Substation Design Specifications***

The Customer can contact a Transmission Accounts representative to request current CNP specifications and applicable bills of material for new substations and substation equipment additions and replacement.



## REVISION HISTORY

VERSION	DATE	ACTION TAKEN	CHANGE TRACKING
1	10/13/2020	Added section 3.1. Operating Personnel Communications.	Kevin Tanzi
2	10/14/2020	Updated section 3.5 Substation and Equipment Identification	Marcos Garza
3	10/15/2020	Updated Contacts.	Greg DonCarlos

**Exhibit "G"**

**Specification for Remote Telemetry of a Customer-Owned Facility**

# SPECIFICATION FOR REMOTE TELEMETRY OF INTERCONNECTIONS



ELECTRIC ENGINEERING DEPARTMENT

P.O. BOX 1700 HOUSTON, TEXAS 77251

**REFERENCE DRAWINGS:** Latest Revisions of  
CenterPoint Energy, CNP Drawing No.BSC-007-400-01 SH.3.  
CenterPoint Energy, Telecom Customer Project Plan.

**REFERENCE SPECIFICATIONS:** Latest Revisions of  
CenterPoint Energy, CNP Specification No. 007-231-14, Customer 138kV Substation Design.

**REFERENCE DOCUMENTS:** Latest Revisions of  
CenterPoint Energy, Transmission & Substation Outage and Clearance Coordination Procedures.  
CenterPoint Energy, Substation IFC Process.

11	08-02-2021	Rewritten	HAL	SPS	SPS
10	07-26-2017	Revised section 5	CWM	HAL	MDB
9	12-13-2016	Revised sections	CWM	HAL	MDB
NO	DATE	REVISION	BY	CH	APP

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# SECTION 1

## GENERATOR INTERCONNECTION FACILITY AND ENERGY STORAGE FACILITY

### 1.1. Typical interconnection arrangement

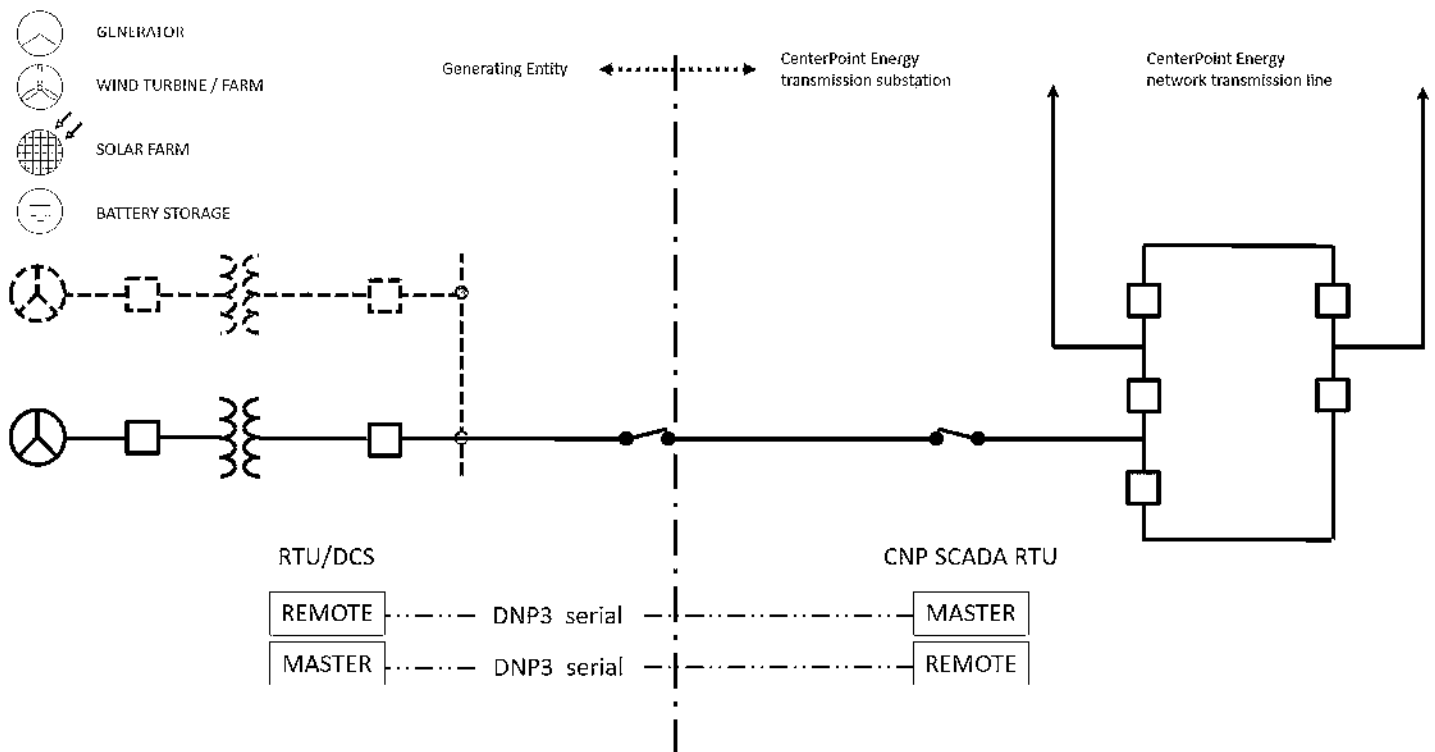


Figure 1 – Typical Generator and Energy Storage facility interconnection arrangement

### 1.2. General SCADA requirements

1.2.1. Installation of a CenterPoint Energy (CNP)-owned SCADA RTU in the customer-owned Generator Interconnection Facility or Energy Storage Facility **is not required**. The customer shall provide data from the customer's RTU/DCS system via a communication medium (such as fiber optic or RS-232/RS-485 cable) to the SCADA RTU in the CNP Transmission Interconnection Facility (TIF) substation. The communication protocol shall be **DNP3 serial**.

1.2.2. The customer shall provide to CNP the following signals originating at the customer facility:

#### 1.2.2.1. Analog data from Plant

- 1.2.2.1.1. Kilovolts for each low-side generator or collector bus (AO scaled as a line-to-line value).
- 1.2.2.1.2. Net megawatts and megavars for each generator feeder (3Ø).
- 1.2.2.1.3. Net megavars for the reactive support equipment (3Ø).
- 1.2.2.1.4. Kilovolts for transmission voltage (AO scaled as a line-to-line value).
- 1.2.2.1.5. Net megawatts and megavars for the transmission line (3Ø).
- 1.2.2.1.6. Frequency at each collector bus.

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- 1.2.2.1.7. Megawatts and megavars for each transformer (3Ø), either on the high side or the low side.
- 1.2.2.2. Status data from Plant
  - 1.2.2.2.1. Status of the transmission voltage circuit breakers.
  - 1.2.2.2.2. Status of all low-side circuit breakers for feeders and reactive support equipment.
  - 1.2.2.2.3. Status of generator automatic voltage regulator (automatic and manual).
- 1.2.3. A separate CNP SCADA RTU serial communication port shall be used to provide data to the customer upon customer's request. CNP shall provide to the customer the following signals originating at CNP's substation:
  - 1.2.3.1. Analog data from CNP
    - 1.2.3.1.1. Kilovolts for the Point of Interconnection (AO scaled as a line-to-line value).
  - 1.2.3.2. Status data from CNP
    - 1.2.3.2.1. Status of transmission voltage circuit breakers associated with the generator lead(s).
    - 1.2.3.2.2. Alarm for failure of Pilot Wire/fiber optic relaying communication channels, if applicable.
- 1.2.4. Real-time telemetry data from ERCOT-Polled Settlement (EPS) meters and revenue meters shall not be shared with the customer through the CNP SCADA RTU or through direct connection(s).
- 1.2.5. All applicable data listed in this section shall be provided continuously to CNP Real Time Operations (RTO), whether through a CNP-owned RTU, through CNP-connected communication ports, or customer-owned SCADA RTU ports. CNP's periodicity for scanning the data from established communication ports and SCADA RTU ports shall be set in accordance with the Electric Reliability Council of Texas (ERCOT) requirements.
- 1.2.6. The customer shall provide plant data to ERCOT according to ERCOT requirements. CNP is not responsible for providing the customer plant data to ERCOT.

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## SECTION 2

### UTILITY INTERCONNECTION

#### 2.1. Typical interconnection arrangement

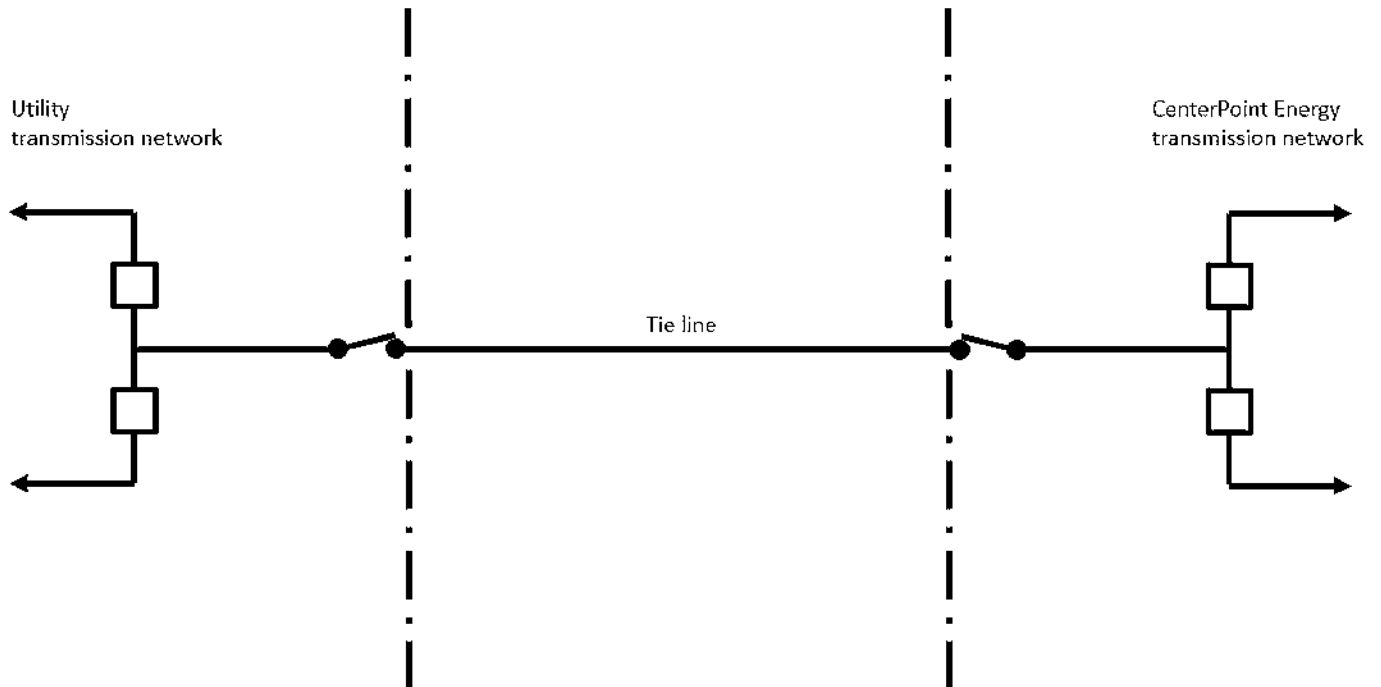


Figure 2 – Typical Utility interconnection arrangement

#### 2.2. General SCADA requirements

2.2.1. SCADA communication options, as agreeable between Utility and CNP:

- 2.2.1.1. If there is a fiber optic cable between Utility's substation and CNP's substation, CNP shall obtain Utility's data via fiber utilizing **DNP3 serial** protocol.
- 2.2.1.2. Where fiber optic cable is not available, Utility shall reserve a serial port with DNP3 serial protocol of Utility's RTU/DCS at the Utility's substation for CNP use. CNP shall connect a communication circuit to the reserved port of Utility's RTU/DCS to obtain data.
- 2.2.1.3. If none of the above options is available, CNP shall install a CNP-owned SCADA RTU with communication circuit to CNP RTO at the Utility's substation. More details of the CNP-owned SCADA RTU are in Section 3 of this specification.

2.2.2. Utility shall provide to CNP the following signals originating at Utility's substation:

- 2.2.2.1. Analog data from Utility
  - 2.2.2.1.1. Kilovolts at the tie point(s) (AO scaled as a line-to-line value).
  - 2.2.2.1.2. Megawatts and Megavars for all transmission lines (3Ø).

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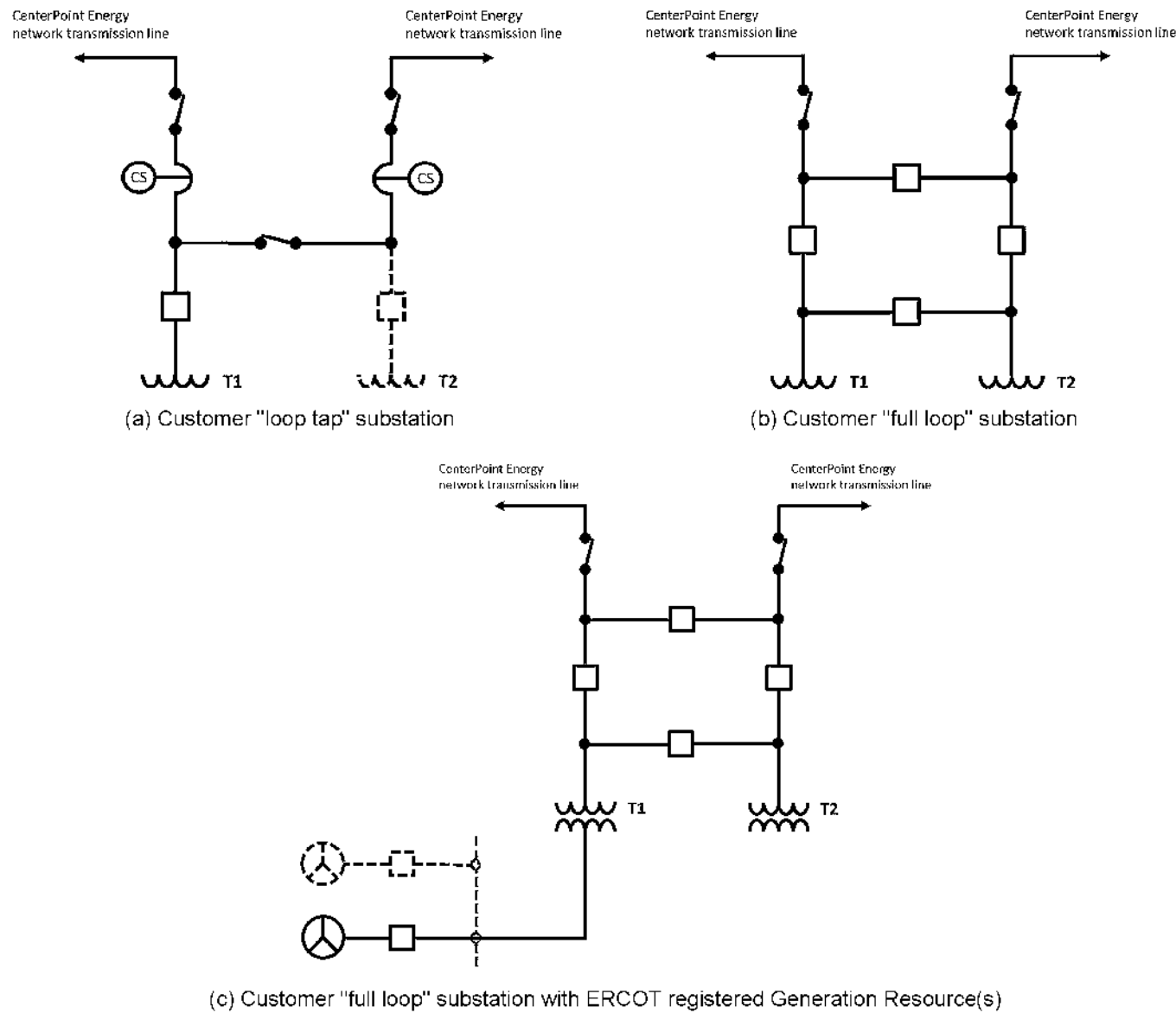
- 2.2.2.1.3. Megavars for all reactive devices.
- 2.2.2.2. Status data from Utility
  - 2.2.2.2.1. Status of the transmission voltage circuit breakers at the tie line voltage.
- 2.2.3. A separate CNP SCADA RTU serial communication port shall be used to provide data to Utility upon Utility's request. CNP shall provide to Utility the following signals originating at CNP's substation:
  - 2.2.3.1. Analog data from CNP
    - 2.2.3.1.1. Kilovolts for the Point of Interconnection (AO scaled as a line-to-line value).
  - 2.2.3.2. Status data from CNP
    - 2.2.3.2.1. Status of transmission voltage circuit breakers associated with the tie line(s).
    - 2.2.3.2.2. Alarm for failure of the tie line Pilot Wire/fiber optic relaying communication channels, if applicable.
- 2.2.4. Real-time telemetry data from ERCOT-Polled Settlement (EPS) meters and revenue meters shall not be shared with the customer through the CNP SCADA RTU or through direct connection(s).
- 2.2.5. All applicable data listed in this section shall be provided continuously to CNP Real Time Operations (RTO), whether through a CNP-owned RTU, through CNP-connected communication ports, or customer-owned SCADA RTU ports. CNP's periodicity for scanning the data from established communication ports and SCADA RTU ports shall be set in accordance with the Electric Reliability Council of Texas (ERCOT) requirements.
- 2.2.6. Utility shall provide data to ERCOT according to ERCOT requirements. CNP is not responsible for providing Utility's substation data to ERCOT.

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**SECTION 3**

**CUSTOMER-OWNED LOAD TRANSMISSION SUBSTATION**

**3.1. Typical interconnection arrangements**



**Figure 3 – Typical customer-owned load transmission substation interconnection arrangements**

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### 3.2. General SCADA requirements

- 3.2.1. Installation of a CNP-owned SCADA RTU in customer-owned facilities **is required** for all new customer-owned load transmission substations, including load customer substations with ERCOT registered generation resource(s).
- 3.2.2. Existing customer-owned substations originally connected without SCADA monitoring shall be required to install a new CNP-owned SCADA RTU when there is a significant change in the topology of the substation or as directed by ERCOT. Existing customer-owned substations with obsolete SCADA equipment shall be required to upgrade the SCADA equipment at CNP's discretion.
- 3.2.3. CNP shall specify and install SCADA equipment as required. The CNP SCADA RTU shall be in a locked cabinet installed in the customer substation control cubicle.
  - 3.2.3.1. The customer shall provide an electrical relaying and metering one-line diagram of the proposed customer-owned substation for review by CNP.
  - 3.2.3.2. The customer shall provide interface equipment such as SCADA electronic panel meters, transducers, status and alarm contacts, cabling, terminal blocks, and conduit to provide the data required in this specification.
  - 3.2.3.3. The customer shall install and maintain voice communication equipment in the customer substation control cubicle.
  - 3.2.3.4. CNP shall specify, install, and maintain a locked Substation Communications cabinet(s) inside the customer control cubicle for SCADA, metering, and other CNP communications needs.
- 3.2.4. The CNP SCADA RTU shall gather data from substation Intelligent Electronic Devices (IEDs) such as microprocessor relays or SCADA electronic meters.
  - 3.2.4.1. IEDs that CNP provides and maintains settings for (i.e. protective relays for CNP transmission network) **are not allowed** to be monitored directly by the customer. The data from these IEDs can be provided to the customer from a serial port on the CNP SCADA RTU.
  - 3.2.4.2. The customer can connect directly to other IEDs such as SCADA electronic meters and microprocessor relays that CNP does not provide and maintain settings for.
- 3.2.5. Most data in the CNP SCADA RTU as described in Section 3.3 below, except CNP transmission network power flow data, shall be available to share with the customer upon customer's request, via a designated DNP3 serial port of the CNP SCADA RTU.
- 3.2.6. Real-time telemetry data from ERCOT-Polled Settlement (EPS) meters and revenue meters shall not be shared with the customer through the CNP SCADA RTU or through direct connection(s).
- 3.2.7. All applicable data listed in this section shall be provided continuously to CNP RTO, whether through a CNP-owned RTU, through CNP-connected communication ports, or customer-owned SCADA RTU ports. CNP's periodicity for scanning the data from established communication ports and SCADA RTU ports shall be set in accordance with the ERCOT requirements.
- 3.2.8. Load customers with ERCOT registered generation resource(s) shall provide plant data to ERCOT according to ERCOT requirements. CNP is not responsible for providing the customer plant data to ERCOT.
- 3.2.9. All equipment and work covered by this specification shall be designed, constructed, and tested in accordance with the latest revisions or editions of industry requirements in effect at the time of fabrication. Industry requirements include the applicable codes, standards, specifications, regulations, tests, and procedures of all federal, state, and local laws, and include (but are not limited to) the following:
  - 3.2.9.1. American National Standards Institute (ANSI)
  - 3.2.9.2. IEEE formerly the Institute of Electrical and Electronics Engineers, Inc.
  - 3.2.9.3. National Electrical Manufacturers Association (NEMA)

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- 3.2.9.4. Occupational Safety and Health Administration (OSHA)
- 3.2.9.5. Federal Communications Commission (FCC)
- 3.2.10. In the event of conflicting requirements, the order of precedence shall be this specification, other referenced CNP specifications, and the standards referenced in Section 3.2.9 above.
- 3.2.11. All equipment, engineering, and installation shall be furnished by the customer unless otherwise noted in this specification or separate agreements.
- 3.2.12. This specification covers the requirements between the customer and CenterPoint Energy and is not meant to cover any additional requirements that the customer may have with ERCOT.

### 3.3. The CNP SCADA RTU subsystems

The CNP SCADA RTU is composed of three subsystems: analog, status, and control.

#### 3.3.1. Analog subsystem

Analog data is typically gathered from IEDs and/or transducers. If transducers are used, CNP shall determine the transducer electrical requirements. See table 1 in the Appendix for acceptable transducer models. Meter test switches are required for the transducer current and voltage connections.

The following analog data shall be monitored by the CNP SCADA RTU:

- 3.3.1.1. Kilovolts for transmission level voltages ( $\Delta\phi$  scaled as a line-to-line value).
- 3.3.1.2. Megawatts and megavars for each line position (3 $\phi$ ).
- 3.3.1.3. Megawatts and megavars for each substation load and/or substation transmission level transformer (3 $\phi$ ).
- 3.3.1.4. Net megavars for transmission reactive support equipment (3 $\phi$ ).
- 3.3.2. Status subsystem
 

The status subsystem of the CNP SCADA RTU shall consist of the following:

  - 3.3.2.1. Status of selected transmission voltage circuit breakers or other devices directly affecting the CNP electrical system, as determined by CNP RTO. Status shall be derived from either an isolated auxiliary "a" contact in the breaker or monitoring a trip coil of the breaker. Refer to Figure 4 in the Appendix for Breaker Status Connection using trip coil monitoring method.
  - 3.3.2.2. Indication of low voltage and battery charger failure is required for the 130 VDC battery system(s). Typical charger alarms include the following: low voltage, high voltage, loss of AC input, and loss of charger. All these indications shall be combined so that an occurrence of any one of these shall cause a single battery alarm (normally open contact) to the CNP SCADA RTU.
  - 3.3.2.3. SCADA Close Inhibit (SCI) indication is required of breakers controlled by SCADA whenever a lockout relay can inhibit breaker closure by SCADA. A dry, normally-open contact from that relay shall be supplied for SCI indication. Indication contacts from all lockout relays shall be wired in parallel for a single indication in the SCADA cabinet. See Figure 4.
  - 3.3.2.4. Indication of Carrier Tester (CAR) or Pilot Wire/Fiber Optic (PIL) relaying failure where applicable.
  - 3.3.2.5. Indication for the loss of a potential to a line relay (PT1) that could cause a mis-operation of the zone. This alarm is typically generated by a contact from the line relay. Indications from separate relays shall be combined for a single alarm.

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- 3.3.2.6. Indication of a failed self-check diagnostic of a microprocessor-based relay, designated as Relay CPU Fail (RCPU). This alarm is typically generated by a contact from the line relay. Indications from separate relays shall be combined for a single alarm.
- 3.3.2.7. Cabinet Alarm (CABS) for the CNP SCADA RTU and the CNP Communications Cabinets. This alarm is generated when the cabinet door is opened.
- 3.3.3. Control subsystem
  - The control subsystem of the SCADA RTU shall consist of the following:
    - 3.3.3.1. CNP shall have remote control of all transmission (69kV, 138kV, 345kV) circuit breakers that directly affect the CNP transmission system as determined by CNP RTO. Dual remote control (control of a breaker by both the customer's control system and CNP RTO) is not permitted. Figure 4 in the Appendix illustrates how SCADA control interfaces with a typical breaker control scheme.
    - 3.3.3.2. CNP shall have remote control, automatic carrier removal (ATCR), of each pilot relaying scheme. A control contact from the SCADA RTU shall be installed in each pilot circuit. See Figure 4 for typical carrier control circuit.
- 3.3.4. For load customer substations with ERCOT registered generation resources, additional data below shall be required by CNP from the customer's Plant. This data is typically obtained via communication from the Plant RTU/DCS to the CNP SCADA RTU.
  - 3.3.4.1. Analog data from Plant
    - 3.3.4.1.1. Kilovolts for each low-side generator or collector bus ( $\Delta\phi$  scaled as a line-to-line value).
    - 3.3.4.1.2. Net megawatts and megavars for each generator feeder (3 $\phi$ ).
    - 3.3.4.1.3. Net megavars for the reactive support equipment (3 $\phi$ ).
    - 3.3.4.1.4. Net megawatts and megavars for the transmission line (3 $\phi$ ).
    - 3.3.4.1.5. Frequency at each collector bus.
    - 3.3.4.1.6. Megawatts and megavars for each transformer (3 $\phi$ ), either on the high side or the low side.
  - 3.3.4.2. Status data from Plant
    - 3.3.4.2.1. Status of all low-side circuit breakers for feeders and reactive support equipment.
    - 3.3.4.2.2. Status of generator automatic voltage regulator (automatic and manual).

#### 3.4. CNP SCADA RTU design, layout, and physical criteria

##### 3.4.1. SCADA RTU designation

The type of SCADA RTU installed by CNP shall depend on the number of controlled breakers.

- 3.4.1.1. For breakered transmission substation configuration such as "full loop", "ring bus", or "breaker-and-a-half", CNP typically installs a free-standing cabinet 24" wide by 18" deep and 72" tall, with front access. Clearance of 30" in front of the door shall be reserved for maintenance access. Substations with more than four transmission breakers may require a larger cabinet(s). Refer to latest customer RTU drawing submitted by CNP at the project kick-off.
- 3.4.1.2. Substations with "loop tap" configuration generally require a smaller, wall-mounted RTU cabinet. The wall-mounted cabinet is 30" wide by 12" deep and 42" tall. Clearance of 30" in front of the door shall be reserved for maintenance access.

3.4.2. Access to the CNP SCADA RTU cabinet shall be controlled by CNP.

##### 3.4.3. Connections to the RTU

The Construction Contractor shall install all interconnections between the CNP

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SCADA RTU and the substation panels.

- 3.4.3.1. The customer shall provide a 120 VAC, fifteen (15) amp, dedicated AC power circuit, protected by a fifteen (15) amp circuit breaker, to the SCADA RTU Cabinet for lighting and a convenience outlet.
- 3.4.3.2. The customer shall provide a 130 VDC, fifteen (15) amp, dedicated DC power circuit, protected by a fifteen (15) amp circuit breaker, to the SCADA RTU Cabinet for the main RTU power.
- 3.4.3.3. All cable shields shall be grounded at a location other than the CNP SCADA RTU Cabinet. Cable shields shall be grounded at one end only.

#### 3.4.4. Cabling

The customer shall size and install all conduit or cable troughs in accordance with ANSI/NFPA 70 (National Electrical Code).

- 3.4.4.1. Polyethylene Polyvinylchloride (PEPVC) insulated shielded 2/C #16 cable with stranded copper conductors shall be used for terminations for all transducer outputs and all RS485 inter-panel connections.
- 3.4.4.2. Breaker controls shall use seven conductor (#12) PEPVC insulated cable with stranded copper conductors for terminations.
- 3.4.4.3. Two conductor (#10 or larger) PEPVC insulated cable with stranded copper conductors shall be used for terminations of the AC and DC power circuit.
- 3.4.4.4. Status and alarms shall be terminated with two conductor (#16) PEPVC insulated cable with stranded copper conductors.
- 3.4.4.5. The customer shall install the necessary conduit or cable management between the SCADA RTU and the relay panels.
- 3.4.4.6. Every breaker with 130 VDC SCADA control circuits shall have breaker coil surge suppression. One 100 [Ω], 11 [W] resistor (Ohmite style 995-10A) and one Zener diode (Motorola type TN3051A) or equivalent shall be used for this suppression. The series combination of the Zener diode and the resistor shall be parallel to each breaker trip and breaker close coil. STATES sliding link terminal blocks shall be installed in the breakers for terminating the resistors and Zener diodes. See Figure 4. CNP shall verify breaker coil surge suppression.

### 3.5. Communication lines and telemetry transport

- 3.5.1. The customer shall provide and maintain a direct-dial telephone landline for voice communications inside the control house cubicle. The phone shall have an extendable cord such that the handset can be stretched to the front of the relay panels and SCADA RTU so they can be viewed and operated by the person using the phone. The telephone landline must continue to operate during a site power failure.
- 3.5.2. CNP shall provide a Telecom transport option for telemetry backhaul and connectivity using one of the following options determined by CNP: CNP microwave, CNP fiber, or leased circuit.
- 3.5.3. For CNP microwave option:
  - 3.5.3.1. CNP shall provide tower height and wind load specifications to the customer.
  - 3.5.3.2. The customer shall procure, install, own, and maintain the tower.
  - 3.5.3.3. The customer to provide 2" conduit from the microwave pole/tower to Telecom Enclosure as per CNP Telecom Customer Project Plan.
  - 3.5.3.4. CNP shall procure, install, own and maintain the microwave radio and related equipment.

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- 3.5.3.5. The customer shall provide a flame retardant coated 4'x 8' sheet of 3/4" plywood for CNP enclosures.
- 3.5.3.6. CNP shall install a communications enclosure on the backboard provided by the customer as shown in CNP Telecom Customer Project Plan, Telecom Board Layout.
- 3.5.3.7. The customer shall install conduits and cables from the communications enclosure to the AC distribution panel, DC distribution panel, ground bus bar, SCADA RTU cabinet, meter can, and the TWS cabinet if there is one. CNP communications equipment requires a dedicated 20A 120VAC power breaker, and a dedicated 20A 130VDC power breaker as shown in CNP Telecom Customer Project Plan, Telecom Board Layout.
- 3.5.4. For CNP fiber option:
  - 3.5.4.1. The customer shall provide a path for the fiber to the control cubicle.
  - 3.5.4.2. The path may be either aerial or underground.
  - 3.5.4.3. CNP shall provide site specific underground or aerial specifications to the customer in a Statement of Work (SOW).
  - 3.5.4.4. The customer shall install the underground duct or poles for aerial installation.
  - 3.5.4.5. The customer shall install fiber supplied by CNP. CNP shall own and maintain the fiber.
  - 3.5.4.6. CNP shall terminate the fiber and install fiber distribution panels.
  - 3.5.4.7. The customer shall provide a flame retardant coated 4'x 8' sheet of 3/4" plywood for CNP enclosures.
  - 3.5.4.8. CNP shall install a communications enclosure on the backboard provided by the customer as shown in Telecom Customer Project Plan, Telecom Board Layout.
  - 3.5.4.9. The customer shall install conduits and cables from the communications enclosure to the AC distribution panel, DC distribution panel, ground bus bar, SCADA RTU cabinet, meter can, and the TWS cabinet if there is one. CNP communications equipment requires a dedicated 20A 120VAC power breaker, and a dedicated 20A 130VDC power breaker as shown in CNP Telecom Customer Project Plan, Telecom Board Layout.
- 3.5.5. For leased circuit option:
  - 3.5.5.1. The customer shall provide a flame retardant coated 4'x 4' sheet of 3/4" plywood space for the Telco demark inside the control cubicle.
  - 3.5.5.2. The customer shall provide a flame retardant coated 4'x 8' sheet of 3/4" plywood for CNP enclosures.
  - 3.5.5.3. CNP shall install a Communications enclosure to be mounted on the backboard provided by the customer as shown in CNP Telecom Customer Project Plan, Telecom Board Layout.
  - 3.5.5.4. The customer shall install conduits and cables from the communications enclosure to the AC distribution panel, DC distribution panel, ground bus bar, SCADA RTU cabinet, meter can, and the TWS cabinet if there is one. CNP communications equipment requires a dedicated 20A 120VAC power breaker, and a dedicated 20A 130VDC power breaker as shown in CNP Telecom Customer Project Plan, Telecom Board Layout.
  - 3.5.5.5. The customer shall provide dedicated 15A 130VDC power and grounding to the backboard. See CNP Telecom Customer Project Plan, Third Party Telco Board Design.

### 3.6. Calibration and maintenance

- 3.6.1. After all equipment necessary for remote telemetry has been installed, CNP personnel shall calibrate and verify operation of all equipment installed per this specification.
- 3.6.2. The RTU and transducers installed per this specification shall be maintained by CNP unless otherwise noted in an agreement with the customer. Maintenance shall

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include accuracy checks, recalibration and replacement/repair of equipment when needed.

- 3.6.3. CNP shall furnish locks in series with customer locks to permit access to all switchyard gates, substation control cubicle door(s), and disconnect switches.

### 3.7. Current transformers and potential transformers

- 3.7.1. The current transformers (CTs) and potential transformers (PTs) necessary for telemetry and protection itemized in this specification shall be provided according to CNP specification 007-231-14. If a particular application is not covered by this specification, then CNP shall designate the necessary PT(s) and CT(s) on the substation one-line diagram that the customer submits for comment and approval.
- 3.7.2. For some substation layouts, a potential rollover circuit shall be needed. If a potential rollover circuit is needed, it shall be designated by CNP on the one-line diagram that the customer submits for comment and approval.

### 3.8. Drawing approval

- 3.8.1. The Engineering Contractor shall provide electronic and paper copies of all drawings showing equipment connections and structural details of all equipment associated with the installation of the CNP-owned RTU at the customer facility.
- 3.8.2. Drawings required by this specification include:
- 3.8.2.1. Substation one-line relaying and metering diagrams illustrating the overall telemetry scheme,
  - 3.8.2.2. Substation control cubicle layout(s) and floor plan(s),
  - 3.8.2.3. Conduit and cable lists,
  - 3.8.2.4. Conduit Layout or Plan and Profile,
  - 3.8.2.5. RTU manufacturers prints and customer connections,
  - 3.8.2.6. AC Schematics for all power and control circuits,
  - 3.8.2.7. AC Relaying Schematics (Electrical Three-Line),
  - 3.8.2.8. Relay panel layouts,
  - 3.8.2.9. Bill of material for items required by this specification,
  - 3.8.2.10. Battery charger alarm relay(s) schematics,
  - 3.8.2.11. AC & DC Distribution Panels,
  - 3.8.2.12. Communication cable and conduit routing through customer facility, and
  - 3.8.2.13. Customer Facility Plot Layout.

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## APPENDIX

Table 1: Acceptable transducers and test switches

DESCRIPTION	MANUFACTURER	MODEL NO.	MONITORING POINTS
VOLTAGE TRANSDUCER	AMETEK SCIENTIFIC COLUMBUS	VT110A4	ONE PER SUBSTATION BUS
TEST SWITCH SINGLE PHASE	DURHAM	2-1022F-03	ONE PER EACH TRANSDUCER
WATT/VAR TRANSDUCER SINGLE PHASE	AMETEK SCIENTIFIC COLUMBUS	XLWV5C5	ONE PER EACH LINE OR LOAD
WATT/VAR TRANSDUCER THREE PHASE	AMETEK SCIENTIFIC COLUMBUS	X1.WV342K5A4	ONE PER EACH LINE, GENERATOR OR LOAD
TEST SWITCH THREE PHASE	DURHAM ABB MEGA POWER SYS STATS	2-1058F-00 FS3A171171001NULL CS3A-556-556-162 FMS #293R-330JT-ST	ONE PER EACH TRANSDUCER

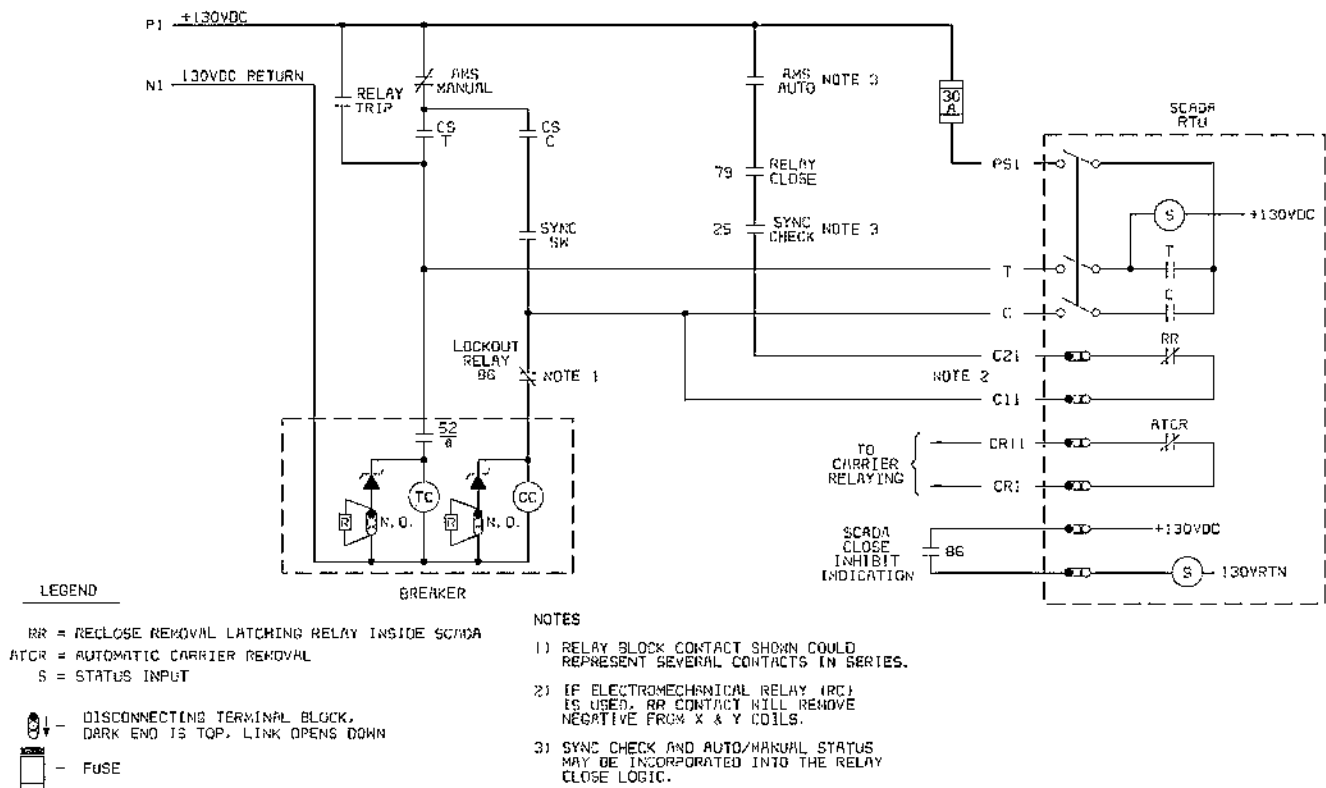


Figure 4 – Breaker Status Connection using trip coil monitoring method

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## List of abbreviations

RTU = REMOTE TERMINAL UNIT

DCS = DISTRIBUTED CONTROL SYSTEM

CR1, CR11 = TYPICAL WIRE NAMES IN CNP CARRIER RELAYING SCHEMES

ATCR = AUTOMATIC CARRIER REMOVAL

C = CLOSE

CS = CONTROL SWITCH

25 = SYNCRO-VERIFIER RELAY

S = SCADA STATUS INPUT

C11, C21 = TYPICAL WIRE NAMES IN CNP RECLOSE REMOVAL SCHEMES

NO = NORMALLY OPEN

CC = BREAKER CLOSE COIL

79 = AUTOMATIC RECLOSING RELAY

RR = RECLOSE REMOVAL LATCHING RELAY

T = TRIP

TC = BREAKER TRIP COIL

SSS = SLIDING LINK TERMINAL

R = RESISTOR

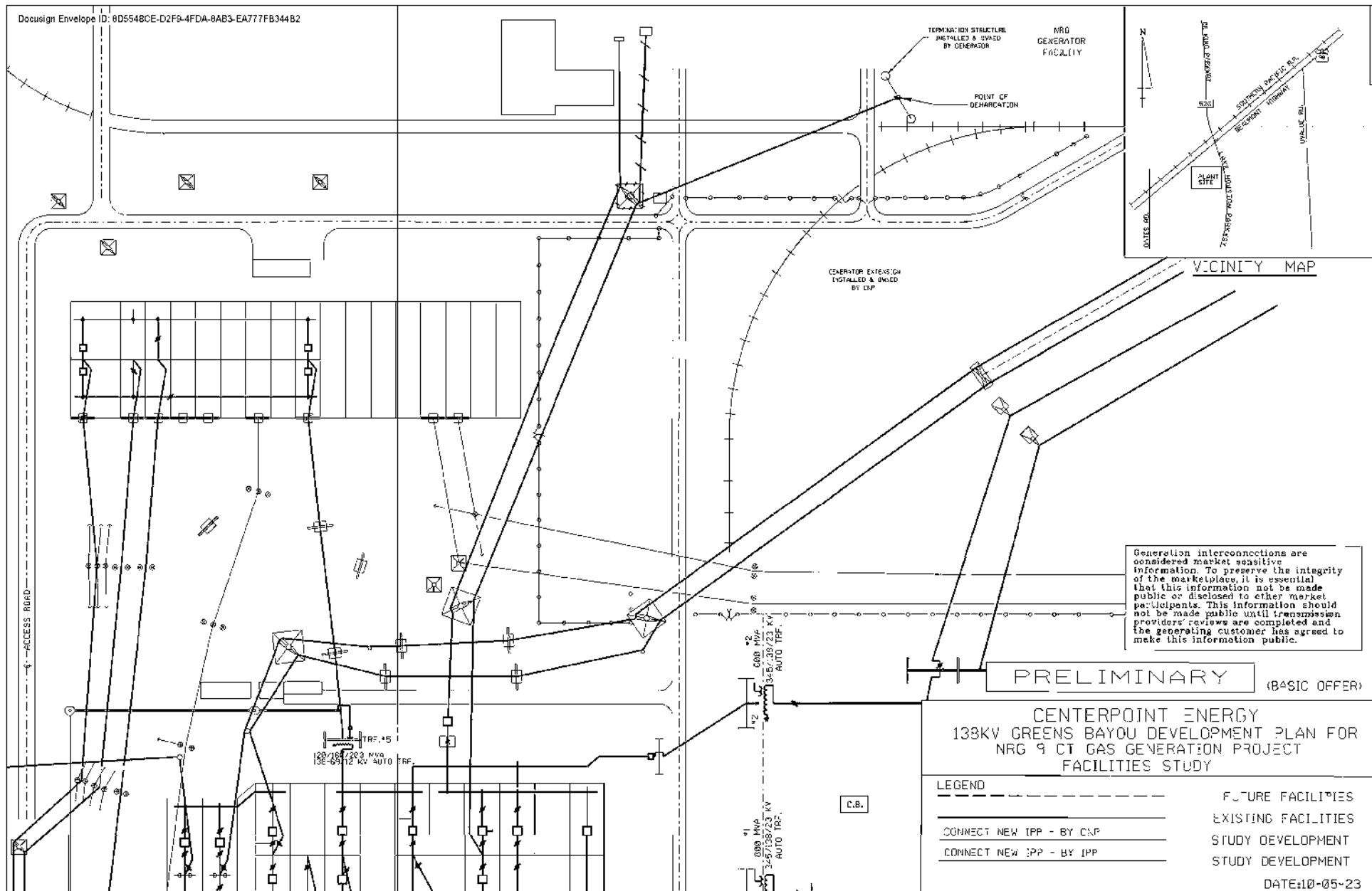
DDD = ZENER DIODE

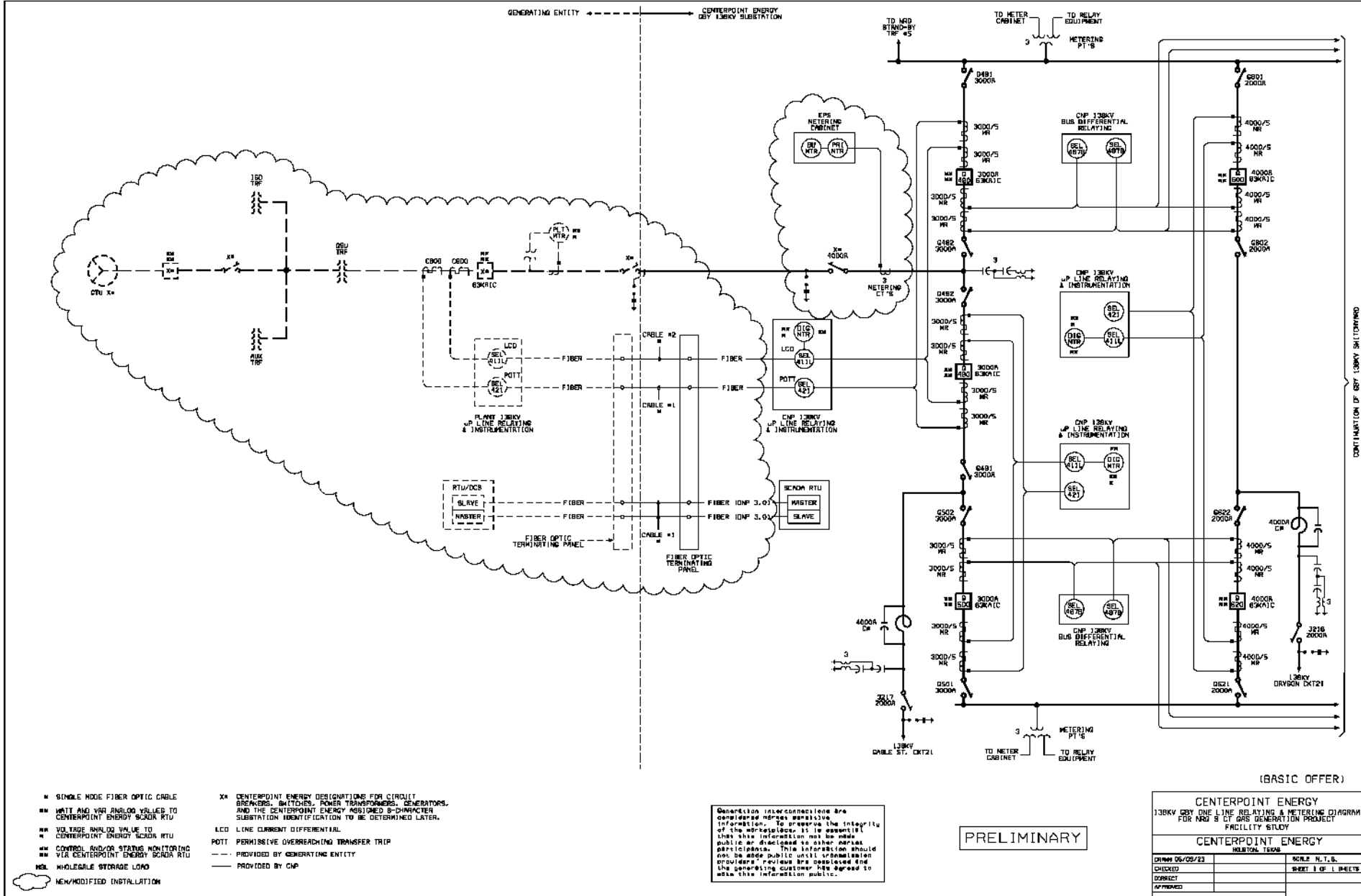
AMS = AUTOMATIC / MANUAL THROWOVER SWITCH (SHOWN IN MANUAL MODE)

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**Exhibit "H"**

**Drawings**





**Exhibit "I"**

**Specification for Customer-Owned 138 kV Substation Design**

# **SPECIFICATION FOR CUSTOMER-OWNED SUBSTATION DESIGN**



**ELECTRIC ENGINEERING DEPARTMENT  
P.O. BOX 1700 HOUSTON, TEXAS 77251**

**SPECIFICATION  
FOR  
CUSTOMER-OWNED 138 kV SUBSTATION DESIGN**



**ELECTRIC ENGINEERING DEPARTMENT  
P.O. BOX 1700 HOUSTON, TEXAS 77251**

REFERENCE DRAWINGS: Latest revision of  
CenterPoint Energy 004-241-04, Customer-Owned Substation Line Termination Standard  
CenterPoint Energy 171-190-06, Design Criteria 138 kV Standard Instrument Transformer Stand, Sh. 1  
CenterPoint Energy 171-190-06, Design Criteria 138 kV Standard Instrument Transformer Stand, Sh. 2  
CenterPoint Energy 581-500-01, 138 kV Potential Transformer Schematic and Wiring Diagram

REFERENCE DOCUMENT: Latest revision of  
CenterPoint Energy Transmission & Substation Outage and Clearance Coordination Procedures

REFERENCE SPECIFICATIONS: Latest revision of  
CenterPoint Energy 007-400-02, Specification for Remote Telemetry of a Customer-Owned Facility

REFERENCE STANDARDS: Latest revision of  
AASHTO/IEEE C57.13  
AISC, "Manual of Steel Construction" IEEE C2 (NESC)  
ASCE 10 IEEE 80  
ASCE 113 IEEE 519  
ANSI C12.1 IEEE 837  
ANSI C37.32 IEEE 998  
IEEE C37.04 IEEE 1119  
IEEE C57.12.00 IEEE 1453  
IEEE 142 NEMA CC 1

						CENTERPOINT ENERGY HOUSTON, TX		
20	10/17/2024	Added 345kV Specification	Var	Var	JPB			
19	1/3/2024	Update to VRT in 3.5 and minor edits	Var	Var	PM	WRITTEN	4/9/74	E. C. Reid
18	9/8/2023	Updates to various sections	Var	Var	PM	CHECKED	4/10/74	L. G. Pond
17	9/2/2021	Update sections 4 & 11	Var	Var	GAC	APPROVED	7/17/74	C. S. Kayser
						Page 1 of 46		
NO	DATE	ITEMS REVISED	BY	CH	APP	SPECIFICATION No. 007-2231-14		



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## 1. **SCOPE**

- 1.1. This specification covers design criteria for a customer-owned 138 kV substation connected to the CenterPoint Energy Houston Electric, LLC (CenterPoint Energy) 138 kV transmission system. This specification is intended to apply to a new customer-owned substation or expansion of an existing customer-owned substation. However, the information in this specification may be applicable when equipment in an existing customer-owned substation is being replaced or modified.

## 2. **GENERAL**

- 2.1. A customer that is approved by CenterPoint Energy to receive service from the CenterPoint Energy 138 kV transmission system is required to provide a substation capable of accepting that service from CenterPoint Energy. The customer-owned substation becomes an integral part of the CenterPoint Energy transmission system network and the Electric Reliability Council of Texas (ERCOT) and, therefore, can have a significant impact on overall system reliability. The customer is obligated to meet present CenterPoint Energy design criteria and modify the customer-owned substation in the future as the CenterPoint Energy transmission system continues to evolve. When deemed necessary by CenterPoint Energy, changes may be needed to conform to industry standards, transmission system characteristics, CenterPoint Energy practices, and technological advances to maintain reliability or meet future reliability requirements.
- 2.2. All equipment and design shall be in accordance with designated standards of this specification, the American National Standards Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), the American Society of Civil Engineers (ASCE), the American Institute of Steel Construction (AISC), and the National Electrical Manufacturing Association (NEMA). In the event of conflicting requirements, the order of precedence shall be this specification, ANSI, IEEE, ASCE, AISC, and NEMA standards. All electrical clearances shall comply with the latest version of the National Electric Safety Code (NESC).
- 2.3. This specification is not intended to be totally comprehensive. To ensure the efficient coordination between CenterPoint Energy and the customer during the design and construction of the customer-owned substation, CenterPoint Energy requires that engineering documents be submitted to CenterPoint Energy for review before certain equipment is ordered or construction begins. All items requiring CenterPoint Energy review are listed in Article 14 of this specification and shall be submitted in writing to the designated CenterPoint Energy representative.
- 2.4. Any deviations from this specification or project drawings reviewed by CenterPoint Energy require written acceptance from CenterPoint Energy.
- 2.5. All labor and equipment shall be furnished by the customer unless otherwise stated in this specification.
- 2.6. Unless otherwise stated in this specification:
- 2.6.1. CenterPoint Energy will provide only functional reviews of completed drawings and schematics.

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- 2.6.2. CenterPoint Energy will not verify, or correct, point-to-point wiring drawings for the customer – owned substation.
- 2.6.3. CenterPoint Energy requires specific tests which are to be conducted by the customer to verify the proper operation and coordination of the customer-owned substation protection and control equipment (see Article 16 of this specification).
- 2.7. CenterPoint Energy reserves the right to refuse to energize any customer-owned substation which fails to meet this specification.
- 2.8. The customer will coordinate the energization and operation of their high voltage facilities with CenterPoint Energy’s Real Time Operations (RTO) Department per CenterPoint Energy’s “Transmission & Substation Outage and Clearance Coordination Procedures” document.
- 2.9. During energization of new or existing equipment, the customer shall not disable a single level, or multiple levels, of protection that results in no protection for an energized element, such as, a transmission line, high voltage bus, or transformers.
- 2.9.1. The customer shall immediately notify the RTO System Controller (281-894-0491) whenever the customer becomes aware of an energized element that has no protection if the protection cannot be immediately restored.
- 2.9.2. The customer shall immediately notify the RTO System Controller (281-894-0491) of a protective relay that is not functional (such as a “CPU Failure” alarm) or when a protective relay is found powered down, or out of service (such as not enabled), for an energized element.
- 2.10. As owner of the substation, it is the customer’s responsibility to comply with the applicable laws, ordinances, codes, rules, and regulations established by applicable government entities.
- 2.11. Because the customer-owned substation becomes an integral part of the CenterPoint Energy transmission system network, CenterPoint Energy requires access to the customer-owned substation and CenterPoint Energy right-of-ways 7 days-a-week, 24 hours-a-day, 365 days-a-year. Site access, site operating procedures and road access to the customer-owned substation by CenterPoint Energy personnel should be considered when determining the substation location.
- 2.12. When terminal blocks and other connections permit, ring tongue lugs shall be used instead of spade or stab-on lugs.

### 3. **CENTERPOINT ENERGY SYSTEM CHARACTERISTICS**

- 3.1. CenterPoint Energy’s phase rotation is designated C-B-A counter-clockwise and the customer shall phase equipment accordingly. Connection of the customer’s H1-H2-H3 power transformer leads to CenterPoint Energy’s C-B-A, B-A-C or A-C-B phases, respectively, is recommended.
- 3.2. The CenterPoint Energy’s system operating voltage is 138kV (L-L)/79.7kV (L-G) +/- 5% for continuous operation and 138kV (L-L)/79.7kV (L-G) +5%/-8% for emergency conditions. Actual steady-state operational voltage varies around the CenterPoint Energy transmission system network,

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but facilities with a means to regulate the 138 kV transmission system are typically used to control the voltage to be no more than approximately 142 kV (L-L)/82 kV (L-G) to provide a margin from the maximum 145kV (L-L)/83.7 kV (L-G). Dynamic conditions may be encountered which result in voltage exceeding this range. At a minimum, customer is required to design 138kV substation facilities that are rated for the emergency operating voltage range stated above. For the purpose of the design and rating of the substation and equipment, it shall be assumed that the maximum continuous negative sequence component of the voltage at the 138 kV bus is 2% of the positive sequence voltage. See Sub-Articles 3.4, 3.5, 4.9 and 7.1.4 of this specification for additional relevant information.

- 3.3. Only instrument transformers, surge arresters, station service voltage transformers, generator step-up transformers for generators without co-located non-auxiliary load, and autotransformers are allowed to be connected phase-to-ground on their 138 kV primary terminals.
- 3.4. As the independent system operator (ISO) for the ERCOT Region, ERCOT is responsible for maintaining frequency, which is nominally 60 Hz. Refer to ERCOT ([www.ercot.com](http://www.ercot.com)) Nodal Operating Guides and Protocols for information regarding frequency regulation.
- 3.5. CenterPoint Energy suggests the customer at a minimum utilize the “voltage ride-through” design criteria below when designing and selecting process and control equipment. (Note: This design criteria do not supersede any regulatory voltage ride-through requirements).
  - 3.5.1. When the point of interconnection bus voltage is below 0.5 pu, the minimum ride-through time is 0.15 seconds.
  - 3.5.2. When the point of interconnection bus voltage is at or above 0.5 pu, the minimum ride-through time is 0.2 seconds.
- 3.6. Multiple-shot, staggered, voltage-supervised, automatic reclosing is utilized on the CenterPoint Energy transmission system. The first automatic reclosing attempt for a CenterPoint Energy transmission line typically occurs approximately one second after initial trip. The number of automatic reclosing attempts varies, but the total duration of the automatic reclosing sequence is typically one minute. The customer shall coordinate operation and protection of electric motors, computers and other equipment accordingly.

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#### 4. **ELECTRICAL DESIGN CRITERIA**

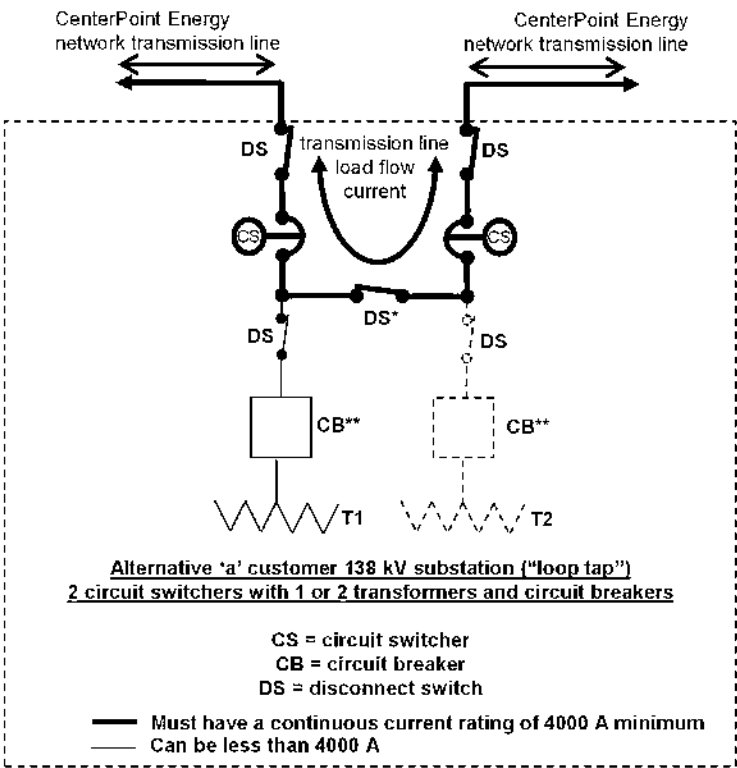
- 4.1. The minimum acceptable electrical design characteristics for 138 kV facilities and equipment are listed below:

Transformer winding impulse level	550 kV BIL
Bus and switch insulators, and apparatus bushings (i.e. circuit breaker bushings, transformer bushings, coupling capacitors, capacitive voltage transformers (CVT), current transformers (CT), potential transformers (PT), surge arresters etc.)	650 kV BIL
Bus and switch insulators leakage distance	132 in. leakage distance (equivalent to extra creep 650 kV BIL or 750 kV BIL). Additionally, insulators may require 'coating' in some areas of the system to minimize the likelihood of flashover.
Apparatus bushing leakage distance (circuit breaker bushings, transformer bushings, CVT, CT, PT, surge arresters etc.)	92 in. creep (equivalent to 650 kV BIL – light contamination levels). Additionally, apparatus bushings may require 'coating' in some areas of the system to minimize the likelihood of flashover.
Phase-to-ground clearance	52 in. (metal to metal)
Phase-to-phase bus spacing (including vertical spacing at crossover point of high and low bus)	63 in. (metal to metal)
Phase-to-phase horizontal spacing at incoming line dead-end structure	144 in. (center line to center line, regardless of the line angle)

- 4.2. An air insulated customer-owned substation configured in a 'ring bus', 'double-breaker, double-bus' or 'breaker-and-a-half' arrangement equipped with transmission line protective relaying ("full loop") or an air insulated customer-owned substation configured in a 'loop line tap' arrangement without transmission line protective relaying ("loop tap") are allowed by CenterPoint Energy (see Figure 2 through Figure 7). 'Ring bus' configurations with more than six breakers shall not be considered.
- 4.3. Customer-owned substations with aggregated load equal to or greater than 75 MW shall be configured as "full loop". Customers shall convert any existing substation to "full loop" if any future load addition increases aggregate load to 75MW or more.
- 4.4. Based on the customer-owned substation configuration, equipment in the substation that could be subjected to transmission line load flow current (circuit breakers and disconnect switches, bus work, conductors or any series-connected, current carrying devices, such as, free-standing current transformers, protective relays, instrumentation, or hardware within the ring bus or transmission line breaker-and-a-half bay) and incoming transmission line positions (transmission line disconnect

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switches, line traps, etc.) shall have a minimum continuous current rating of 4000 A and shall have an overload capability of 110 percent of rated current for 2 hours, unless otherwise specified by CenterPoint Energy. The equipment in the customer-owned substation that is not subjected to transmission line load flow current is not required to be 4000 A minimum. However, operational scenarios associated with certain equipment outages could exist that would result in transmission line load current flowing on customer internal lines or buses (customer site internal 'loop line' or customer site internal 'loop bus') and potentially overload the customer's equipment if it is rated less than 4000 A. Therefore, CenterPoint Energy suggests that any customer site internal 'loop line' and customer site internal 'loop bus' (except customer site internal 'radial' line or customer transformer bus connections) be 4000 A minimum (see Figure 2 through Figure 7). For customer-owned substations connecting to four or more CenterPoint Energy 138 kV transmission lines, contact CenterPoint Energy for the required equipment rating.

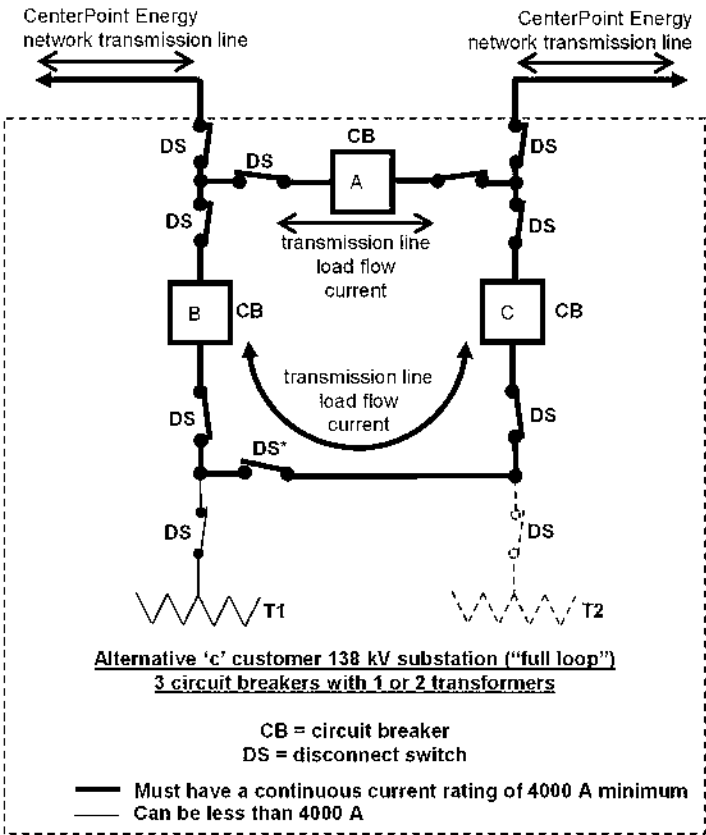


All disconnect switches only have arcing horns. Circuit switchers are required to be installed in this configuration. The circuit switchers are used for manual switching of the network transmission line sections. If two transformers are installed then this disconnect switch is installed and is 'normally closed'.  
\*\* For substation arranged for future "full loop" service, the 138 kV circuit breakers that will be in the substation 'loop' shall have a continuous current rating of 4,000 A (see figures 3 to 7)

Figure 2

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All disconnect switches only have arcing horns. Circuit switchers are not used for manual switching of the network transmission line sections in this configuration. The circuit breakers are used for manual switching of the network transmission line sections..

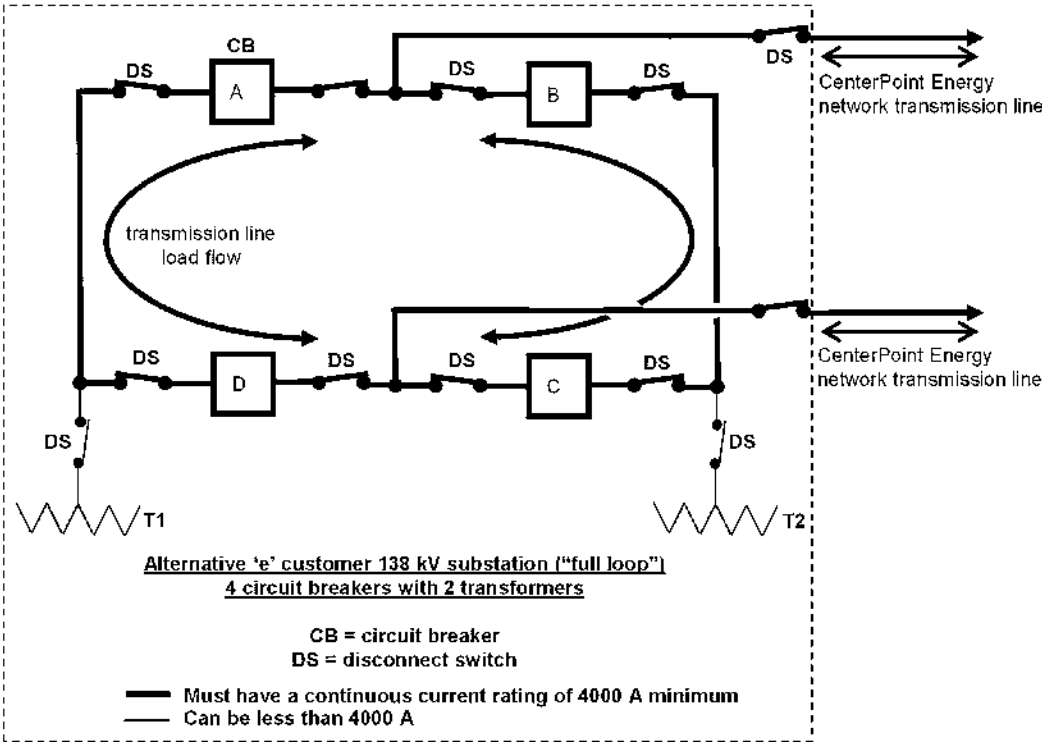
\* If two transformers are installed then this DS is 'normally open' or 'normally closed' depending on customer operating preference.

Figure 4

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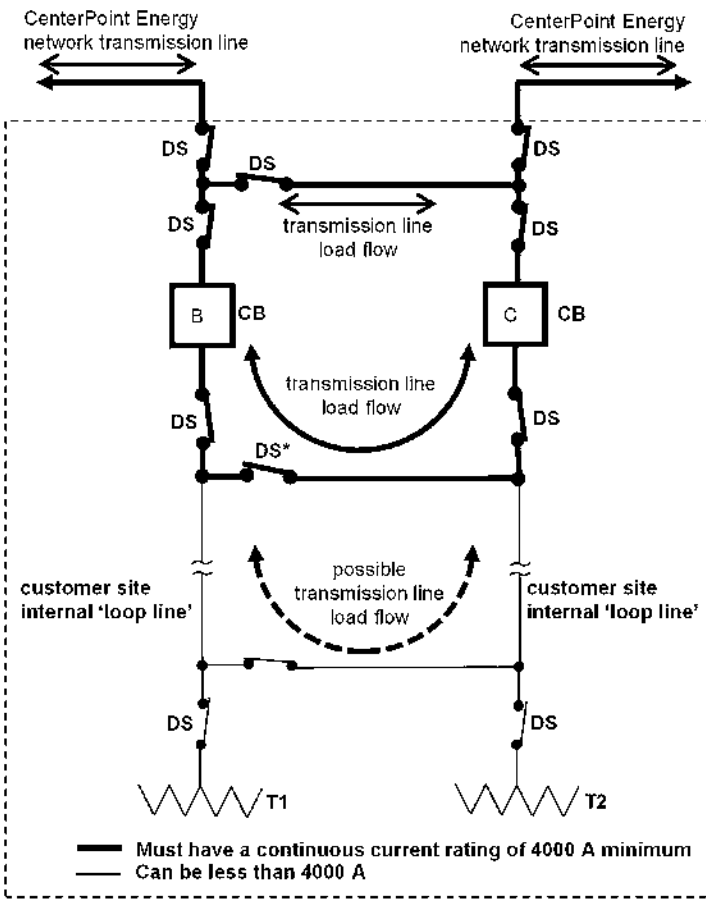




All disconnect switches only have arcing horns. Circuit switchers are not used for manual switching of the network transmission line sections in this configuration. The circuit breakers are used for manual switching of the network transmission line sections.

Figure 6

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Any customer connection from the "full loop" substation or "loop tap" substation to the customer's transformers, customer buses, or customer lines (i.e. customer plant internal 'loop lines', etc.) are not required to be 4000 A minimum. However, operational scenarios after a scheduled outage of equipment in a customer substation could exist that would result in transmission line load current flowing on customer site internal lines or buses (customer site internal 'loop line' or 'loop bus') and potentially overload the customer's equipment if it is rated less than 4000 A. Therefore, CenterPoint Energy suggests that any customer site internal 'loop line' and customer site internal 'loop bus' (except customer site internal 'radial' line or customer transformer bus connection) be 4000 A minimum.

Figure 7

- 4.5. The 138 kV customer-owned substation shall be designed for a short circuit current of 63 kA rms symmetrical, with X/R ratio of 17, unless otherwise specified by CenterPoint Energy.
- 4.6. 138 kV customer-owned substations which are connected directly into or located within 2 miles electric distance of a CenterPoint Energy 138 kV substation that is designed for a short circuit current of 80 kA rms symmetrical, must be designed to the same short circuit current of 80 kA rms symmetrical, with X/R ratio of 17, unless otherwise explicitly specified by CenterPoint Energy.

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- 4.7. The application of key interlock systems is not permitted on customer-owned substation 138 kV equipment.
- 4.8. The customer's connected load, generation and equipment shall be designed and operated to adhere to the recommended harmonic limits of IEEE 519 and limits of voltage fluctuations and associated light flicker of IEEE 1453.
- 4.9. The customer shall not, without CenterPoint Energy's consent, connect or operate equipment that produces voltage fluctuations, interference or distorted wave forms that adversely affect service to other customers or that may be detrimental to the CenterPoint Energy transmission system. Such equipment includes, but is not limited to, motors, arc furnaces, capacitor banks, etc. The customer is obligated to provide load and equipment information (i.e., load magnitude, peak load, load profile, amount of self-serve generation, load characteristics, motor starting data, load increase) for CenterPoint Energy interconnection study and development of interconnection requirements. CenterPoint Energy may require the installation, on customer's side of the meter, of suitable apparatus or other equipment designed specifically to reasonably limit such adverse effects.
- 4.10. The customer-owned substation ground mat shall be designed for a short circuit current of 63 kA rms symmetrical with X/R ratio of 17 and duration of 0.25 seconds and comply with IEEE 80 and IEEE C2 (NESC). Ground mat connections shall comply with IEEE 837, unless otherwise specified by CenterPoint Energy.
- 4.11. 138 kV customer-owned substations which are connected directly into or located within 2 miles electric distance of a CenterPoint Energy substation that is designed for a short circuit current of 80 kA rms symmetrical, shall design the ground mat for a short circuit current of 80 kA rms symmetrical, with X/R ratio of 17 and duration of 0.25 seconds and comply with IEEE 80 and IEEE C2 (NESC). Ground mat connections shall comply with IEEE 837, unless otherwise specified by CenterPoint Energy.
- 4.12. The customer-owned substation direct lightning stroke shielding design shall comply with IEEE 998.
- 4.13. The customer shall refer to the current CenterPoint Energy tariff for retail delivery service regarding additional information pertaining to load balance, intermittent electrical loads and limitations on adverse effects, equipment sensitive to voltage and wave forms, change in retail customer's electrical load, power factor, and testing of retail customer equipment.

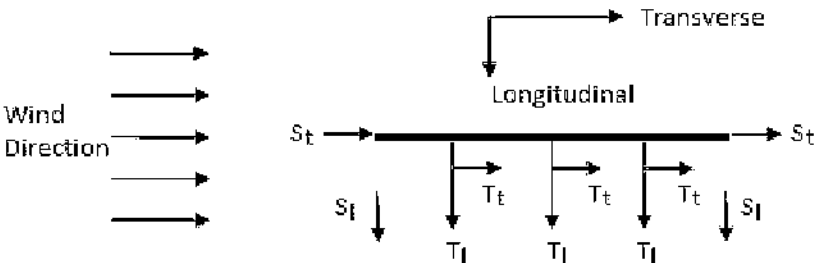
## 5. **STRUCTURAL AND MECHANICAL DESIGN CRITERIA**

- 5.1. The customer shall provide a complete structural and foundation design package for the dead-end structures (supporting the CenterPoint Energy transmission lines connected to the customer-owned substation) and the instrument transformer stands in accordance with Article 14 of this specification. The design package shall be signed and sealed by a professional engineer registered in Texas and shall include design references/codes, computer analysis, member design, connection design, foundation design, soil report, structural and foundation drawings, and all other information that documents the design of the structure(s). ASCE 113, 2<sup>nd</sup> Edition may be used for guidance in the design of structures inside the customer-owned substation.
- 5.2. CenterPoint Energy transmission structures designated for CenterPoint Energy use shall be used

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exclusively by CenterPoint Energy and will not be used to support customer equipment including customer-owned generator leads.

- 5.3. Design shall be based upon loadings realistically combined to cause the most unfavorable effect upon the structure or component. The loads and overloads specified in Sub-Articles 5.4 and 5.5 of this specification must be used. If the AISC LRFD method is used, the structure must have a second order elastic analysis (also called a Geometric Nonlinear Analysis).
- 5.4. Structures shall meet the Strength Requirements of IEEE C2 (NESC), Section 26, for grade B construction.
- 5.5. The minimum acceptable structural design loading criteria shall be the more severe of the following two cases (note the cases incorporate loads up to a 30° horizontal angle):
  - 5.5.1. Case 1 - Ice with Concurrent Wind Loading: Reference specification IEEE C2 (NESC); minimum allowable strength factors per Section 26, Table 261-1; loading requirements per Section 25, Rule 250.B and Table 250-1; and loading components to be applied to the structure shall be according to Figure 8 of this specification. The static wire and phase wire loads shown in Case 1 include the required overload factors. The 9 psf wind on the structure must include a 2.50 overload (22.5 psf) with the appropriate force coefficient ( $C_f$ ) for each structural member.



Wind and Ice loads are specified in Section 25 of IEEE C2

Static wire	Phase wire
$S_l$ = 10.5 kips/wire longitudinally	$T_l$ = 23.0 kips/phase longitudinally
$S_t$ = 6.7 kips/wire transversely	$T_t$ = 14.4 kips/phase transversely
$S_v$ = 0.5 kips/wire vertically	$T_v$ = 1.5 kips/phase vertically

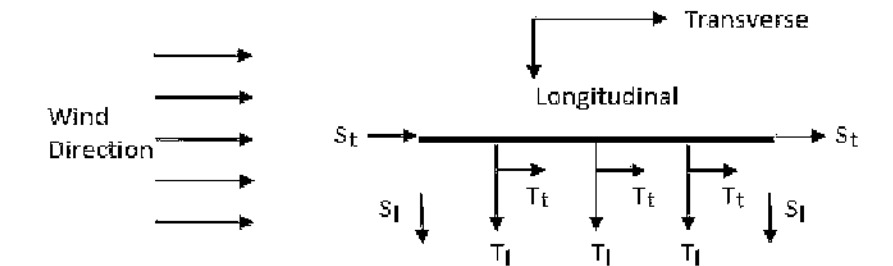
CASE 1 - Ice with concurrent Wind Loading – Overhead  
View Static wire and Phase wire loading component  
(The static wire and phase wire loads shown include the required overload factors)

Figure 8

- 5.5.2. Case 2 - Extreme Wind Loading: Reference specification: IEEE C2 (NESC) Section 25, Rule 250.C; minimum allowable strength factors per IEEE C2 (NESC), Section 26, Table 261-1;

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and magnitude and direction of static wire and phase wire loading components to be applied to the structure shall be according to Figure 9 of this specification. The static wire and phase wire loads shown in Case 2 include the required CenterPoint Energy overload factors. The wind on structure loads is applied in the Transverse direction and must include a 1.1 overload factor. CenterPoint Energy will provide the designated Extreme Wind velocity to be used at the site. Structural member shape factors shall be used from ASCE 74.



For Case 2 the following shall apply:  
Basic Wind speed determined from wind map for, Exposure Category C,  
Risk Category I, Design wind pressure equation and coefficients  
per IEEE C2 (NESC) Rule 250.C in latest version

Static wire	Phase wire
$S_l = 12.0$ kips/wire longitudinally	$T_l = 22.0$ kips/phase longitudinally
$S_t = 5.5$ kips/wire transversely	$T_t = 10.5$ kips/phase transversely
$S_v = 0.5$ kips/wire vertically	$T_v = 1.5$ kips/phase vertically

CASE 2 - Extreme Wind Loading – Overhead View  
Static wire and Phase wire loading component  
(The static wire and phase wire loads shown include the required overload factors)

Figure 9

- 5.6. The requirements for dead-end structures are as follows:
- 5.6.1. Customer shall design all attachment points to ensure that sufficient electrical clearance is maintained to the customer’s structure ground and equipment. CenterPoint Energy will extend the phase wires to the first item of customer’s equipment or bus and will furnish, own and maintain all necessary fittings for terminating the phase wires including the tower fittings, suspension insulators, dead-end clamps and phase wire terminal fittings with NEMA CC 1 standard four-hole terminals (0.5625 in. diameter holes, 1.75 in. centers) for attachment to the first item of equipment or bus in the customer-owned substation. CenterPoint Energy will also furnish stirrup clamps or other similar devices (such as a bar on the NEMA pad that is used with ACSS conductors) on the phase wires as required for connection of surge arresters and potential transformers. Customer will provide a grounding conductor from the customer-owned substation ground mat, up the dead-end structure, to the static wire pull-off plates.

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CenterPoint Energy will furnish, own and maintain all necessary fittings for terminating the static wire and for connecting the static wire to the customer provided substation ground conductor at the static wire pull-off plates including the tower fittings, dead-end clamps and static wire terminal fittings for attachment to the customer provided substation ground conductor.

- 5.6.2. Customer shall provide pull-off plates for terminating the phase wires and static wires which will accommodate a minimum of 1 in. pin. All pull-off plates must satisfy Equations 4.6-1 and 4.6-2 in ASCE 10. Details for division of ownership shall be in accordance with CenterPoint Energy Drawing 004-241-04 Customer-Owned Substation Line Termination Standard.
- 5.6.3. The height of the dead-end structure's phase wire attachment shall be in accordance with the National Electric Safety Code (IEEE C2) or 40 ft. whichever is greater, unless otherwise specified by CenterPoint Energy. The static wire height at attachment shall be at a sufficient elevation and position to provide a shield angle to the outside phase wires of 30° and 45° between two adjacent static wires (see IEEE 142).
- 5.6.4. CenterPoint Energy will determine if the installation of fiber optic cable is required for transmission line protective relaying and/or control purposes. The fiber optic cable installation will normally be installed underground from the transmission line protective relay requiring fiber optic communication (i.e., relay located in the substation control cubicle) to the base of the first CenterPoint Energy transmission line structure outside the substation. However, should an overhead installation be required, additional loadings will be imposed on the customer's dead-end structure. Additional design information concerning the fiber optic cable will be supplied by CenterPoint Energy when overhead fiber optic cable is to be used. The connection for the fiber optic cable is typically at least 8 feet from the nearest phase wire. If an overhead installation is required and the fiber optic cable cannot be accommodated on the dead-end structure, a single pole must be installed in the customer-owned substation to transition the fiber optic cable from overhead to underground.
- 5.6.5. If multiple dead-end bays are installed that share a middle column or support, the support must be designed to withstand the loads from the adjacent circuits.
- 5.7. When high-side (138 kV) metering is utilized, the customer shall design, provide and install stands for mounting CenterPoint Energy furnished instrument transformers (potential and current transformers). The customer shall also design and build foundations to support the stands and instrument transformers. The designs shall be in accordance with Sub-Articles 5.1- 5.4 of this specification. The extreme wind speed defined in section 5.5.2 shall be used with an appropriate member and equipment shape factor. The instrument transformer parameters to be used for the design of the instrument transformer stand are indicated on CenterPoint Energy drawing 171-190-06. Since the instrument transformer may change in the future, the stand mounting surface for the instrument transformer must be adjustable or use grating to accommodate diverse mounting bolt patterns. If a grating is used for the stand mounting surface for the instrument transformer, washer plates of sufficient size and thickness to load up 4 bars must be used on top and bottom of the grating. Design calculations showing the load transfer from the bolt to the washer plates to the bars to the column must be provided. The customer is responsible for providing the bolts and washer plates. The customer will design a mounting stand and foundation for the hurricane wind speeds and overloads

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from Sub-Article 5.5.2 of this specification. If the AISC LRFD method is used, the structure must have a second order elastic analysis (also called a Geometric Nonlinear Analysis). The customer shall limit the horizontal deflection of the potential transformer and current transformer stand at the instrument mounting height to the mounting height divided by 100. The wind speed used for the deflection limit shall be 80 mph.

## 6. SITE CRITERIA

- 6.1. Site preparation and plot plan drawings shall be submitted to CenterPoint Energy for comment. Facilities that must be shown on this drawing include: dimensions of the customer-owned substation site, access roadways, space between the customer-owned substation and access roadways, and drainage features such as culverts, ditches and detention facilities (if required). Refer to Sub-Article 14.1.1 of this specification.
- 6.2. The customer shall stake the location of the dead-end structures according to Figure 10. The owner of the substation must submit drawings/documents specific to their substation to CenterPoint Energy in accordance with Article 14 of this specification. The drawings required by Sub-Articles 14.1.1 and 14.1.3 of this specification should show the customer's desired location for CenterPoint Energy phases. CenterPoint Energy will review this information along with the customer-owned substation location and CenterPoint Energy transmission line tower location and determine if the customer's desired location for CenterPoint Energy phases can be achieved.

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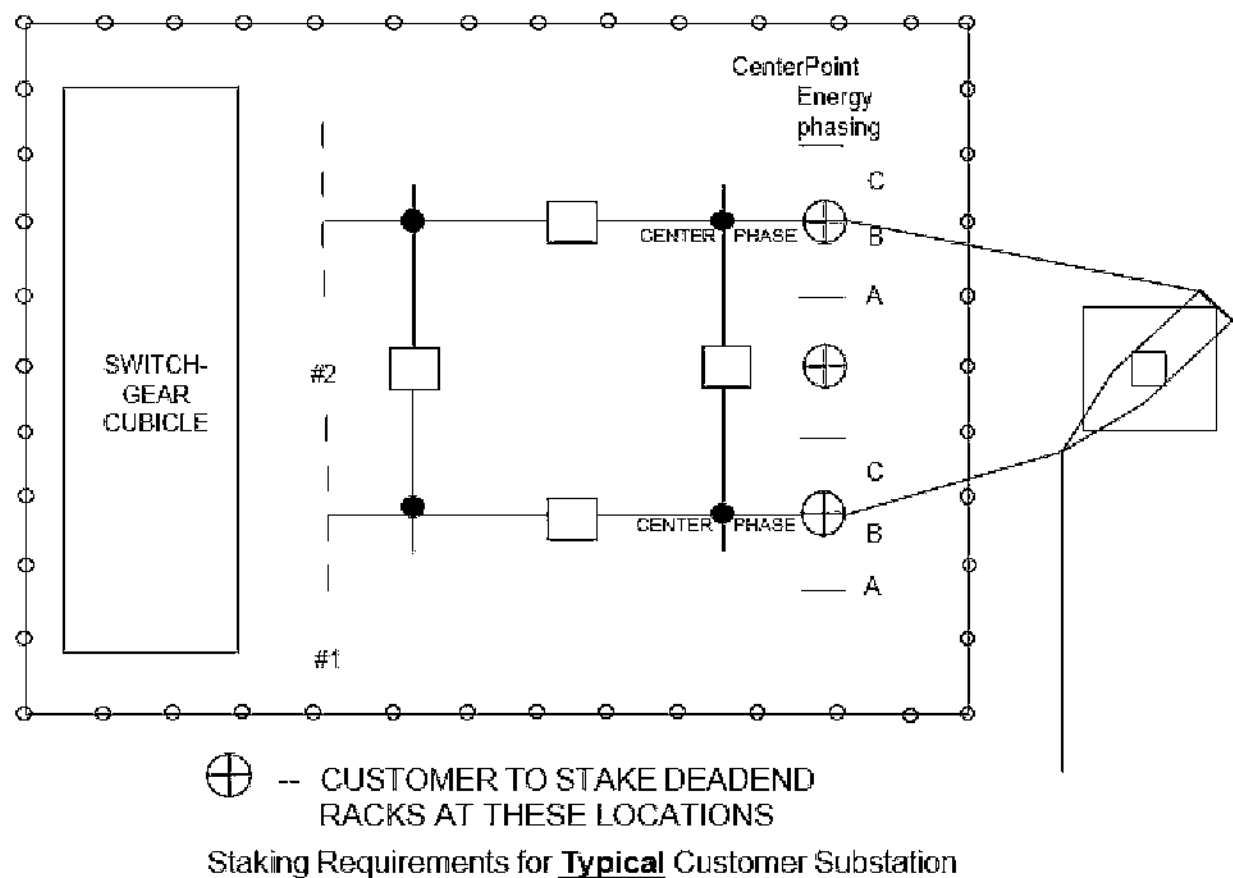


Figure 10

- 6.3. An all-weather access roadbed capable of supporting heavy construction vehicles shall be provided to the customer-owned substation. The areas within the customer-owned substations that need to support heavy vehicular traffic should conform to AASHTO H20 loading.
- 6.4. Access for CenterPoint Energy to attach its transmission line wires to the customer-owned substation dead-end structures shall be provided by either:
- 6.4.1. A 25 ft. wide, leveled, and unobstructed access outside the customer-owned substation site from a main road to the CenterPoint Energy right-of-way and in front of the dead-end structures with substation fencing a maximum of 20 ft. from the attachment point of the dead-ends and a 13 ft. (minimum) wide gate for access into the customer-owned substation.
- 6.4.2. A 25 ft. wide access inside the customer-owned substation from the substation access gate (20 ft. wide minimum) to the front of the dead-ends with substation fencing a minimum of 25 ft. from the attachment point.

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- 6.5. Access and space shall be provided for installation and future replacement of high voltage equipment including metering instrument transformers.
- 6.6. The design elevation of the customer-owned substation site, equipment and control cubicle should take into consideration locating essential components above flood and storm surge levels.

## 7. **HIGH VOLTAGE EQUIPMENT**

7.1. The requirements for power transformers are as follows:

- 7.1.1. Transformers serving load shall have a delta winding for connection to the 138 kV system. Power transformers shall conform to IEEE C57.12.00. Power transformers should be equipped with sudden pressure and low oil level detection devices.
- 7.1.2. Power transformers shall have a minimum of two 600:5 A multi-ratio bushing current transformers (BCTs) per 138 kV bushing. Each BCT shall have IEEE C57.13 accuracy C400 or better. Where applications require additional BCTs and/or different ratios, CenterPoint Energy shall provide ratios to support equipment purchase schedule. The secondary resistance of power transformer BCTs shall not exceed 0.0025 ohms per turn. The power transformer BCT secondary rated continuous current shall be 10 A minimum. The power transformer BCT rating factor (R.F.) shall equal 2.0.
- 7.1.3. High-side surge arresters shall be provided in accordance with Sub-Article 7.4 of this specification.
- 7.1.4. The customer shall determine the need for, and if applicable, settings for a transformer tap changer for de-energized operation (no load tap) and automatic on-load tap changer. CenterPoint Energy recommends power transformers be equipped with an automatic on-load tap changer.

7.2. The requirements for circuit breakers are as follows:

- 7.2.1. Circuit breakers shall be of the three-pole, outdoor type, 138 kV nominal, in accordance with IEEE C37.04.
- 7.2.2. For a "full loop" customer-owned substation, "loop tap" substation, or a substation arranged for future "full loop" service, the 138 kV circuit breakers that are or will be in the substation 'loop' shall have a continuous current rating of 4,000 A, an overload capability of 110 percent of the rated current for 2 hours and a rated isolated capacitor bank current switching capability of 600 A.

For customer-owned substations connecting to four or more 138 kV CenterPoint Energy transmission lines, circuit breakers may be required to have a higher continuous rating. The three-phase symmetrical short circuit current interrupting capability of all 138 kV circuit breakers shall be 63 kA rms symmetrical. The rated interrupting time of all 138 kV circuit breakers shall be three cycles or less. In some applications, the installation of TRV shaping capacitors may be required in order to achieve the circuit breaker interrupting capability of 63 kA rms symmetrical for line faults. CenterPoint Energy shall determine the placement of

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TRV shaping capacitors, when required for line faults.

- 7.2.3. Each 138 kV circuit breaker shall be equipped with two 4000:5 A multi-ratio BCTs per 138 kV bushing. Each circuit breaker BCT shall have a relaying accuracy class of C800 on the 4000:5 A tap in accordance with IEEE C57.13. The secondary resistance of the circuit breaker BCT shall not exceed 0.0025 ohms per turn. The circuit breaker BCT secondary rated continuous current shall be 10 A minimum. The circuit breaker BCT rating factor (R.F.) shall equal 2.0.

For the replacement or addition of a 138 kV circuit breaker in an existing customer-owned substation that already has other 138 kV circuit breakers that do not have a continuous current rating of 4,000 A, the following applies to the replacement or addition circuit breaker (i.e., the following requirement is to accommodate interface of the 4000 A replacement or addition 138 kV circuit breaker with any existing circuit breakers that have 2000:5 multi-ratio BCT's in an existing substation while maintaining the design capability for 4000 ampere operation in the future). Each replacement or addition 138 kV circuit breaker shall be equipped with two 3000:5 A multi-ratio BCTs per 138 kV bushing. Each circuit breaker BCT shall have a relaying accuracy class of C800 on the 2000:5 A tap (equivalent to C1200 on the full ratio 3000:5) in accordance with IEEE C57.13. The secondary resistance of circuit breaker BCTs shall not exceed 0.0025 ohms per turn. Circuit breaker BCT secondary rated continuous current shall be 10 A minimum. Circuit breaker BCT rating factor (R.F.) shall equal 2.0.

- 7.2.4. Two trip circuits shall be provided with independent 125 V DC control circuits. If two trip coils operate a single armature, both coils shall be designed or marked in such a way as to prevent their being connected in a manner that would result in the circuit breaker not tripping in the event that both coils are energized simultaneously.
- 7.2.5. Trip circuit or close circuit DC current shall not exceed 15 A (instantaneous and steady state) for the circuit breaker trip or close circuit. If electromechanical protective relays with DC operated 'target and seal-in' units are used in the substation, then the circuit breaker trip circuit shall not draw less than 4 A DC current and a circuit breaker close circuit shall not draw less than 2 A DC current in order ensure reliable 'target and seal-in' unit operation.
- 7.2.6. The DC negative of a trip circuit shall not be fused or use a circuit breaker inside the circuit breaker control cabinet.
- 7.2.7. Surge suppression shall be provided on each trip and close coil. Reference CenterPoint Energy 007-400-02 Specification for Remote Telemetry of a Customer-Owned Facility.
- 7.2.8. The circuit breaker operating mechanism shall be both mechanically and electrically trip-free in any position. For oil circuit breakers, a latch check switch shall be provided.
- 7.2.9. Circuit breakers with air closing mechanisms shall have stored energy for at least 5 close-open operations. Circuit breakers with spring closing mechanisms shall have the spring charging motor circuit connected to a 125 V DC battery source utilizing a DC supply cable dedicated for this purpose. Voltage rollover from AC to DC shall not be installed for the spring charging motor circuit for circuit breakers.

- 7.2.10. Gas circuit breakers shall have low SF6 gas pressure alarm and close inhibit contacts.

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The customer shall indicate on the relay and metering one-line diagram whether the low SF6 gas pressure wiring is set to 'BLOCK TRIP' or to 'AUTO TRIP' the circuit breaker.

- 7.2.11. Circuit breaker internal time delay circuitry for reclosing shall not be utilized. External time delayed automatic reclosing, when utilized, shall be wired/connected directly to the circuit breaker close circuit. External time delay for the circuit breaker closing circuit is to be provided by the automatic reclosing scheme.
- 7.2.12. The circuit breaker internal close and trip circuits shall not go through a 'local/remote' control switch in the circuit breaker. However, if a circuit breaker comes from the manufacturer with a 'local/remote' control switch installed in the circuit breaker, then the 'remote' contact of the control switch that is wired in series with the close and trip circuits must be 'shorted out' or 'by-passed'.

7.3. The requirements for air break switches are as follows:

- 7.3.1. Transmission line disconnect switches and all disconnect switches in the customer-owned substation 'loop' shall be of the outdoor, three pole, gang operated type rated 145 kV nominal, and shall have minimum continuous current rating of 4000 A, an overload capability of 110 percent of rated current for 2 hours and a rated minimum withstand capability of 164 kA peak for at least 1.5 seconds. Disconnect switches that are not in the substation 'loop' (i.e., transformer high-side disconnect switch) may be rated for less than 4000 A continuous, but must have a rated minimum withstand capability of 164 kA peak. The switch air gap BIL shall coordinate with the BIL rating of the switch insulators. For customer-owned substations connecting to four or more CenterPoint Energy 138 kV transmission lines, contact CenterPoint Energy for the required rating of switches.
- 7.3.2. Transmission line disconnect switches are required for all substation types.
- 7.3.3. "Loop tap" substations must be configured and designed with equipment to permit switching for the scheduled outage of either transmission line section without interrupting service to the customer's load. An interrupting device attached to a disconnect switch in a "loop tap" substation for transmission line load breaking, loop switching or line dropping is not acceptable.
- 7.3.4. CenterPoint Energy does not require any 138 kV disconnect switch auxiliary contacts except as indicated in Sub-Article 9.1.5 of this specification.
- 7.3.5. Grounding switches are not permitted on 138 kV equipment. A 'grounding stud' or fabricated attachment for the application of temporary grounding cables may be installed if desired.

7.4. The requirements for surge arresters are as follows:

- 7.4.1. Surge arresters must be installed on 138 kV power transformers and in the substation on the incoming transmission line positions to protect substation 138 kV equipment including 138 kV coupling capacitors, line traps, instrument transformers, circuit breakers, etc.
- 7.4.2. All surge arresters shall be metal oxide type, 108 kV class minimum, with a minimum required maximum continuous over-voltage (MCOV) rating of 88 kV. The minimum required energy absorption capability is 7 kilojoules/ kV of MCOV rating. The surge arrester

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must have a minimum required pressure relief capability of 63 kA rms symmetrical (or short circuit current rating of 63 kA rms symmetrical). In addition to meeting the CenterPoint Energy minimum requirements, a surge arrester with well-designed directional pressure relief ports can provide a benefit. In the event of a surge arrester internal short circuit, a surge arrester with well-designed directional pressure relief vent ports, and with the vent ports pointed in the appropriate direction, can minimize the possibility that the ionized gas emitted from the surge arrester will propagate into a multiphase fault and can minimize the possibility of the ionized gas, and possibly other materials emitted from the surge arrester from causing damage to other equipment.

- 7.4.3. All 138 kV surge arresters must be connected with a copper bond wire from the bottom flange of the arrester to the substation ground mat. If the customer desires to allow for grading / leakage current monitoring, the surge arresters may be mounted on plates using insulated spacers and associated hardware. The insulated copper ground conductor from the bottom flange of the arrester must be isolated from any other ground until it passes the point where a long ammeter reading can be taken. The independent, insulated ground leads should be adequately marked to indicate A, B, and C phases.

7.5. The requirements for coupling capacitors or CVTs and line tuners are as follows:

- 7.5.1. CenterPoint Energy shall specify vendor and vendor style number for the coupling capacitor or CVT devices that are used for transmission line protective relaying or CenterPoint Energy supervisory control and data acquisition (SCADA) remote telemetry monitoring of CenterPoint Energy transmission lines according to CenterPoint Energy provided bill of materials. CenterPoint Energy shall specify vendor and vendor style number for the line tuners that are used for transmission line protective relaying according to CenterPoint Energy provided bill of materials.
- 7.5.2. The line tuner must be mounted at a level suitable for adjusting and testing while standing on the ground. The line tuner must be mounted at the base of the coupling capacitor stand to minimize the length of the carrier lead-in conductor connected between the line tuner and the coupling capacitor to reduce the stray capacitance and leakage to ground that will increase the losses of the tuner and affect the bandwidth.
- 7.5.3. The coupling capacitor or CVT shall not be used to structurally support the line trap. Refer to Sub-Article 7.6.3 of this specification.

7.6. The requirements for line traps are as follows:

- 7.6.1. CenterPoint Energy shall specify vendor and vendor style number for line trap devices that are used for transmission line protective relaying according to CenterPoint Energy provided bill of materials.
- 7.6.2. The line trap shall have a minimum continuous current rating of 4,000 A, and an overload capability of 110 percent of the rated current for 2 hours.
- 7.6.3. The line trap shall not be structurally supported by a coupling capacitor or CVT. Refer to Sub-Article 7.5.3 of this specification.

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## 8. **CONTROL CUBICLE**

- 8.1. The control cubicle shall be a permanent, weatherproof structure constructed on a concrete foundation and scheduled for completion well in advance of the remainder of the substation to allow for adequate check out and testing. The ambient conditions inside the control cubicle shall not exceed 32°C (90°F) and 85% relative humidity. Adequate lighting shall be provided.
- 8.2. Wall space for metering boxes shall be provided in accordance with Sub-Article 9.1.3.1 of this specification.
- 8.3. If CenterPoint Energy has specified that transmission line protective relaying with power line carrier and/or fiber optic communication is utilized, power line carrier transmitter/receiver sets shall be procured by the customer according to CenterPoint Energy provided bill of material and/or the customer will provide wall space or floor space for a CenterPoint Energy provided fiber optic cable distribution box.
- 8.4. The customer shall provide space for the CenterPoint Energy remote telemetry equipment that will be installed in accordance with Sub-Article 12.1 of this specification.
- 8.5. A separate 120 V AC, 20 A circuit shall be provided to each of the following: (a) one of the metering boxes, (b) the power line carrier equipment location, and (c) the SCADA RTU cabinet (see CenterPoint Energy 007-400-02 Specification for Remote Telemetry of a Customer-Owned Facility).
- 8.6. One 120 V AC, 20 A outlet for protective relay testing equipment shall be located near the transmission line protective relays in the substation control cubicle.
- 8.7. A separate 130 V DC, 15 A circuit shall be provided to each of the following: (a) one of the metering boxes, and (b) the SCADA RTU cabinet (see CenterPoint Energy 007-400-02 Specification for Remote Telemetry of a Customer-Owned Facility).
- 8.8. If CenterPoint Energy transmission line fault location traveling wave system (TWS) equipment is to be installed, CenterPoint Energy will provide requirements.

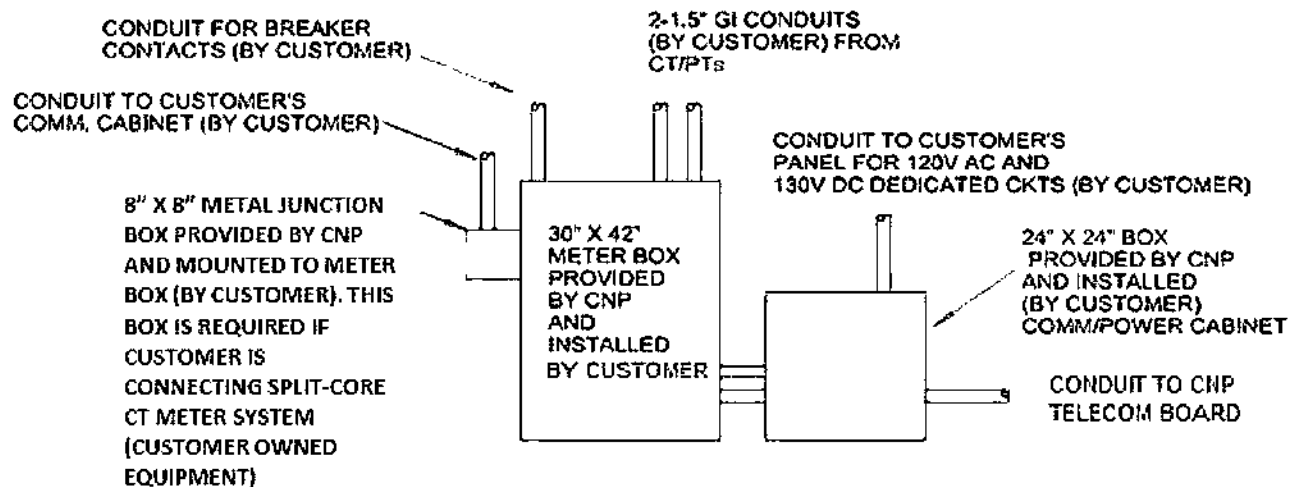
## 9. **METERING EQUIPMENT**

- 9.1. The requirements for metering are as follows:
  - 9.1.1. Any part of the metering system that is installed by the customer or his agent shall conform to ANSI C12.1 at minimum, unless otherwise specified by CenterPoint Energy.
  - 9.1.2. The customer shall submit a one-line diagram of the proposed substation configuration to CenterPoint Energy in accordance with Article 14 of this specification. CenterPoint Energy will designate on the one-line diagram the location of all metering instrument transformers (including, without limitation, quantity, transformation ratios, voltage class - high-side or low-side and ratings). The metering instrument transformers shall be connected to the transformer low-side or to the 138 kV substation bus by the customer as specified by CenterPoint Energy.

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9.1.3. Metering boxes shall be located inside an environmentally controlled cubicle.

9.1.3.1. Each metering box is 30 inches wide, 42 inches high, 12 inches deep, wall mounted and approximately 36 inch from the floor. Wall space 3.0 ft. wide and 8.0 ft. high measured from the floor with 4.0 ft. (from wall) front clearance shall be provided for installation and maintenance of each metering box as illustrated in **Figure 11**. Metering boxes will be furnished by CenterPoint Energy and installed by the customer. The number of metering boxes will be determined by the metering scheme to be used.



**Typical Layout of Meter Boxes**

**Figure 11**

9.1.3.2. A customer requesting metering data shall provide all conduits and wiring necessary to connect to a meter comm/power box provided by CenterPoint Energy and mounted on the metering installation.

9.1.3.3. The customer shall provide a conduit from the CenterPoint Energy telecom board to the metering comm/power box.

9.1.4. CenterPoint Energy personnel will make all meter connections. For metering equipment details, consult the CenterPoint Energy project representative.

9.1.5. When high-side metering is used in a “full loop” alternative ‘c’ or alternative ‘d’ type substation (see Figure 4 and Figure 5), the customer shall provide and wire two auxiliary ‘52a’ contacts from the circuit breaker between the two transmission lines (‘A’ circuit breaker) and a single auxiliary ‘52a’ contact for each of the other two transmission line circuit breakers (‘B’ and ‘C’ circuit breakers) to the CenterPoint Energy high voltage metering box. Also, in a “full loop” alternative ‘c’ type substation (see Figure 4) with two transformer substation, two auxiliary ‘89a’ contacts shall be provided on the disconnect switch between transformers and wired to the CenterPoint Energy high voltage metering box. When high-side metering is used in a “full loop” alternative ‘c’ type substation (see Figure 6), the customer shall provide

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and wire a single auxiliary '52a' contact for each of the other two transmission line circuit breakers ('A', 'B', 'C' and 'D' circuit breakers) to the CenterPoint Energy high voltage metering box. When high-side metering is used in a "loop tap" alternative 'b' type substation (see Figure 3), the customer shall provide two auxiliary '89a' contacts from the disconnect switch located in the substation bus between the transmission line connections and a single auxiliary '52a' contact from each of the circuit breakers. The customer shall provide and install cable from these contacts to the metering location (routed via the protective relay panels) for 'rollover' of the metering potential to a second set of potential transformers.

- 9.1.6. When low-side metering is utilized, as determined by CenterPoint Energy, customer shall provide and install 138 kV CVT devices in accordance with Sub-Article 7.5 of this specification.

9.2. The requirements for switchgear mounted metering instrument transformers are as follows:

- 9.2.1. Where low-side metering is used, as determined by CenterPoint Energy, the customer shall install CenterPoint Energy specified metering instrument transformers in their switchgear.

9.2.1.1. The customer shall purchase and install the CenterPoint Energy specified metering instrument transformers.

9.2.1.2. Original certified test data shall be provided to CenterPoint Energy for each metering instrument transformer installed.

- 9.2.2. Metering current transformers shall be located in the incoming main breaker cubicle. The metering current transformers shall be installed by the customer.

- 9.2.3. Metering potential transformers shall be located in roll-out boxes. The potential transformers shall be installed by the customer.

9.2.3.1. The secondary windings shall be used only for CenterPoint Energy metering.

9.2.3.2. Potential transformers shall be equipped with 1 A, current limiting primary fuses.

- 9.2.4. The customer shall install a 1.5 in. rigid galvanized steel conduit from each instrument transformer cubicle to the meter box.

- 9.2.5. CenterPoint Energy shall supply cable for all metering instrument transformer secondary connections. The customer shall pull the CenterPoint Energy provided cable. CenterPoint Energy shall make all metering instrument transformer secondary connections.

- 9.2.6. The customer shall supply copper ground wire from the customer's switchgear to the CenterPoint Energy meter box.

9.3. The requirements for 138 kV metering instrument transformers are as follows:

- 9.3.1. When 138 kV metering is used, CenterPoint Energy will furnish all 138 kV metering instrument transformers (i.e., separate 138 kV 'free-standing' current and potential transformers) required for CenterPoint Energy revenue metering or ERCOT Polled

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Settlement metering ("EPS").

- 9.3.2. CenterPoint Energy will mount the instrument transformers on stands provided by the customer in accordance with Sub-Article 5.6 of this specification. The substation layout and location of the 138 kV metering instrument transformers shall incorporate the requirement of vehicle access up to the instrument transformers for installation, testing and future replacement (i.e., vehicle access not obstructed by substation bus, cable tray, etc.). The customer shall furnish flexible connections from the substation bus to the instrument transformers with NEMA CC 1 standard four-hole terminals (0.5625 in. diameter holes on 1.75 in. centers). CenterPoint Energy personnel will bolt the flexible connections to the instrument transformers.
- 9.3.3. The customer shall utilize rigid galvanized steel conduit, flexible metallic conduit and pull boxes, including pull string, for the cables/conductors from the metering instrument transformers to the metering box location.
- 9.3.3.1. For each set of current or potential transformer stands, 1.50 in. rigid galvanized steel conduit shall be used to connect the individual instrument transformers to a common junction box for this set of instrument transformers (i.e., one common junction box for each set of current or potential transformer stands) located on or near the base of one of the instrument transformer stands. The 1.50 in. conduit shall terminate within 12 in. from the top of each instrument transformer stand. A 2.00 in. rigid galvanized steel conduit shall be used from each common junction box located at the base of one of the instrument transformer stands to the metering box.
- 9.3.3.2. All 2.00 in. rigid galvanized steel conduit shall terminate at the base of the primary metering box. No more than four conduits are to be terminated in a metering box. Contact CenterPoint Energy if additional conduits are required.
- 9.3.3.3. Flexible metallic conduit shall be used as needed to complete the installation to the instrument transformers, common junction boxes, and the metering box(es).
- 9.3.4. Potential transformers for revenue metering located in the 138 kV substation yard shall be furnished and installed by CenterPoint Energy on instrument transformer stands provided by the customer. The potential transformers will be rated 80,500/115-67.08 V for use on 138 kV grounded neutral system in accordance with IEEE C57.13.
- 9.3.4.1. The potential transformers will have three secondary windings (i.e., "X", "Y", and "Z"). The "X" and "Z" windings will be used for transmission line protective relaying, SCADA and the customer's equipment. The "Y" winding will be used exclusively for CenterPoint Energy metering.
- 9.3.4.2. A minimum 16 inches wide, 14 inches high, 6 inches deep potential transformer common junction box and secondary fuses shall be provided and installed by the customer and located at the base of one of the potential transformer stands. Each secondary winding shall be separately fused at the potential transformer junction box to provide circuit isolation and short circuit protection; except that neutrals shall not be fused (brass or copper dummy fuses required).

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9.3.4.3. CenterPoint Energy shall supply cable/conductors for the potential transformers “Y” winding secondary connections. The customer shall supply cable/conductors for the potential transformers “X” and “Z” windings secondary connections. The customer shall pull the CenterPoint Energy provided cable/conductors and customer supplied cable/conductors. CenterPoint Energy shall make the potential transformers “Y” winding secondary connections. The customer shall make the potential transformers “X” and “Z” windings secondary connections. The potential transformer cables/conductors shall be connected as shown on CenterPoint Energy drawing 581-500-01 138 kV Potential Transformer Schematic and Wiring Diagram.

9.3.4.4. The potential transformer primary shall be wye connected with a solid ground connection at the potential transformer location. The potential transformer secondary windings shall be wye connected with one neutral conductor per set of “X” and “Z” windings carried to the transmission line protective relay panel and another neutral conductor for the “Y” winding will be carried to the meter box, as shown on CenterPoint Energy Drawing 581- 500-01 138 kV Potential Transformer Schematic and Wiring Diagram. These neutral conductors shall be grounded at the transmission line protective relay panel and meter box only.

9.3.4.5. If any 138 kV potential transformer “X” or “Z” winding of any phase is not used for any relaying, SCADA or customer’s equipment, the secondary “3” terminal of any unused winding must be connected to a conductor that is grounded at a panel in the control cubicle.

9.3.5. Metering current transformers located in the 138 kV substation yard shall be furnished and installed by CenterPoint Energy on instrument transformer stands provided by customer.

9.3.5.1. CenterPoint Energy shall supply cable for the metering current transformer’s secondary connections. The customer shall pull the CenterPoint Energy provided cable. CenterPoint Energy shall make the metering current transformer’s secondary connections.

9.3.5.2. A minimum 16 inches wide, 14 inches high, 6 inches deep current transformer common junction box shall be provided and installed by the customer and located at the base of one of the current transformer stands.

9.3.6. The customer shall provide a copper bond wire from the ground mat to the case of each instrument transformer. The wire shall be sized equal to the ground mat. CenterPoint Energy will terminate and connect the wire at the instrument transformer case.

## 10. **FUSING AND CONNECTION OF PROTECTION AND CONTROL AND METERING CIRCUITS**

10.1. Mersen Ferraz Shawmut type A2Y, A2K or A2D or Littelfuse type KLNR fuses shall be used for fusing of the 138 kV potential transformers secondary relaying and metering circuits of less than 250 V AC as follows:

10.1.1. 138 kV potential transformers secondary “X” winding and “Z” winding shall be fused with 30 A fuses at the potential transformer junction box in the yard except that neutrals shall not

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be fused (brass or copper dummy fuses required).

- 10.1.2. 138 kV potential transformers secondary "Y" windings shall be fused with 60 A fuses at the potential transformer junction box in the yard except that neutrals shall not be fused (brass or copper dummy fuses required).
- 10.1.3. 15 A fuses shall be used for protective relaying potential branch circuits.
- 10.1.4. 6 A fuses shall be used for instrumentation potential branch circuits.
- 10.2. Mersen Ferraz Shawmut type A2Y, A2K or A2D or Littelfuse type KLNK fuses shall be used for fusing of 138 kV coupling CVT secondary relaying and instrumentation circuits of less than 250 V AC as follows:
  - 10.2.1. CVT secondary windings shall be fused with 6 A secondary fuses at the CVT junction box in the yard except that neutrals shall not be fused.
  - 10.2.2. 3 A fuses shall be used for protective relaying potential branch circuits.
- 10.3. Mersen Ferraz Shawmut type A2Y, A2K or A2D or Littelfuse type KLNK fuses shall be used for fusing of relaying DC circuits of less than 250 V DC as follows:
  - 10.3.1. The trip circuit connection from the control cubicle panel to each 138 kV breaker trip coil shall be fused with a 15 A panel mounted fuse located on the appropriate control cubicle panel.
  - 10.3.2. 30 A fuses shall be used for the CenterPoint Energy SCADA control positive.
- 10.4. The voltage drop from the control cubicle to the trip circuit at the circuit breakers shall not exceed 10% of rated battery voltage under normal expected operating conditions.
  - 10.4.1. With outdoor circuit breakers and indoor protective relay and control panels, a routing method herein called "radial", shall be used since the dc circuitry to the circuit breakers radiates outward from the control cubicle. Routing of the conductors is from the dc supply to the protective relay and control panels or switchboards and then on to the circuit breakers. Positive and negative conductors are carefully routed together so that sudden changes in current, such as those from tripping a circuit breaker, do not result in large magnetic coupling to other control and measuring conductors. The effects of external magnetic fields tend to cancel when the "go" and "return" conductors are in close proximity. All wires of a circuit should be contained in the same cable so that all are affected similarly by any inductive coupling.

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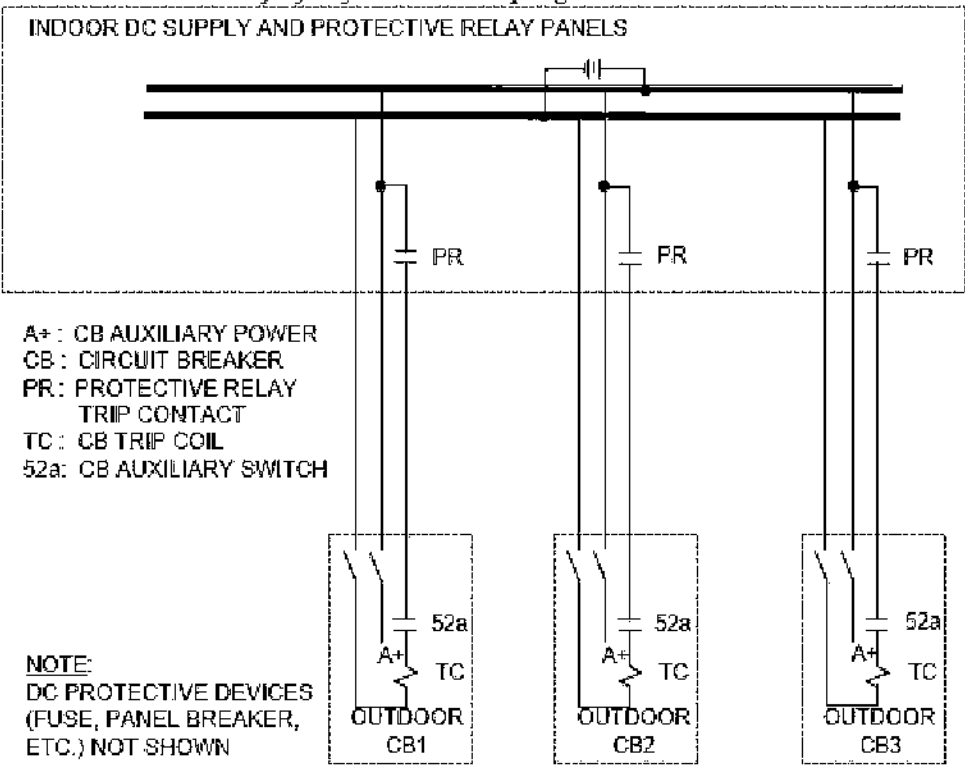


Figure 12

11. **PROTECTIVERELAYING FOR HIGH VOLTAGE (138 KV)**

11.1. The customer will procure and own all the protective relays in the substation. A “full loop” substation configuration requires 138 kV transmission line protective relaying (including transmission line protective relay communication channels), 138 kV transmission line automatic reclosing and local breaker failure relaying for all 138 kV circuit breakers. CenterPoint Energy will specify in a bill of materials, as indicated in Sub-Article 11.3 of this specification, the protective relay style numbers for the multifunction (i.e., 138 kV transmission line protective relaying, circuit breaker automatic reclosing and local breaker failure relaying) microprocessor 138 kV transmission line protective relays. If the customer desires to install single function protective relays that are dedicated for breaker failure relaying, then the customer must consult CenterPoint Energy during the development of the relaying and metering one line diagram regarding which relays CenterPoint Energy personnel will calculate relay settings, apply the settings and test. CenterPoint Energy will specify in a bill of materials, as indicated in Sub-Article 11.3 of this specification, the manufacturer and protective relay type for the single function protective relays that are dedicated for breaker failure relaying. CenterPoint Energy will calculate and implement relay settings for customer-owned 138 kV transmission line protective relays, for single function protective relays that are dedicated for breaker failure relaying for only the circuit breakers that switch the CenterPoint Energy transmission lines and for customer-owned 138 kV relays installed to prevent back- energizing CenterPoint Energy’s

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transmission system from generation installed on the low-side of customer power transformers. CenterPoint Energy will not consider customer requests for programing additional items in the transmission line protective relay for customers use (i.e., relay elements, inputs or outputs, etc.). The customer may request information be exported from the transmission line protective relay that are CenterPoint Energy's standard programing of the relay (i.e., metering values, events, relay elements, inputs or outputs, etc.) via a communication port to the CenterPoint Energy SCADA RTU. On a case-by-case basis, CenterPoint Energy may issue settings for other customer-owned relays. In accordance with Sub-Articles 11.2 and 11.3, and 11.5 of this specification, the customer will propose 138 kV bus, 138 kV transformer protective relay schemes and, for "full loop" substation configurations, breaker failure relaying for all circuit breakers that do not switch the CenterPoint Energy transmission lines. The customer shall submit to CenterPoint Energy the customer calculated relay settings for, and allow CenterPoint Energy to observe the functional testing of, the 138 kV bus and 138 kV transformer protective relay schemes and breaker failure relaying for all circuit breakers that do not switch the CenterPoint Energy transmission lines.

11.2. Protective relaying for elements that compose the 138 kV facilities (i.e., 138 kV transmission lines, 138 kV buses, 138 kV power transformers, etc.) shall consist of two independent schemes for the protection of each element. The protective relays associated with the first scheme shall be connected to a different set of current transformers than the relays associated with the second scheme. The DC branch circuit associated with one relaying scheme (i.e., relay power supply, input, outputs, etc.) shall be a different DC branch circuit than the DC branch circuit associated with the second relaying scheme (i.e., independent DC branch circuit). Each of the two schemes shall energize both trip coils of a circuit breaker using appropriate DC separation and separate output contacts.

11.3. To ensure coordination with other transmission system protective relaying for a "full loop" substation configuration, CenterPoint Energy will furnish typical AC and DC schematics and a minimum required bill of materials for the protective relay style numbers for the multifunction (i.e., 138 kV transmission line protective relaying, circuit breaker automatic reclosing and local breaker failure relaying) microprocessor 138 kV transmission line protective relays including protective relay communication channel equipment. The customer shall indicate the CenterPoint Energy specified transmission line protective relaying schemes and proposed relaying schemes for each 138 kV bus (including 138 kV transformer high-side bus) and transformer protection on a substation relaying and metering one line diagram. Once CenterPoint Energy has reviewed these schemes, the customer shall submit the appropriate relaying drawings and customer's bill of materials to CenterPoint Energy for functional review. After these drawings and the bill of materials are reviewed by CenterPoint Energy, the customer shall order the appropriate equipment and install these schemes. CenterPoint Energy personnel will calculate set points for the multifunction microprocessor 138 kV transmission line protective relays, apply the settings and test the transmission line protection relays after the customer has completed point- to-point wiring checks of protective relaying and control panels and verified protective relaying control circuits by performing functional trip and close testing as described in Article 16 of this specification. The customer shall calculate set points for the 138 kV bus and transformer protection relays and submit this information to CenterPoint Energy for review. After CenterPoint Energy has reviewed the 138 kV bus and transformer protection set points, the customer will apply the settings and test the relays after the customer has completed point-to-point wiring checks of protective relaying and control panels and verified protective relaying control circuits by performing functional trip and close testing as described in Article 16 of this specification. IT SHALL BE THE CUSTOMER'S RESPONSIBILITY TO INSTALL ALL WIRING AND PEFORM ALL POINT-TO-POINT WIRING CHECKS AND CORRECT ANY WIRING

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## ERRORS.

- 11.4. A 'Sync Panel' is required only for a "full loop" substation configuration. The Sync Panel consists of a synchroscope, a voltmeter and three sync lights. The 'Sync Panel' typically consists of a small subpanel mounted on hinges to one of the substation protection and control panels and must be visible from the location of the 138 kV circuit breaker control switches. Other arrangements may be acceptable (i.e., 'Sync Panel' components mounted on the same protection and control panel that all of the 138 kV circuit breaker control switches are mounted on). CenterPoint Energy will specify the 'Sync Panel' requirements in a bill of materials referenced in Sub-Article 14.1.2 of this specification.
- 11.5. For "full loop" substations equipped with transmission line protective relaying, the current carrying capability of the components in the protective relaying schemes (relay devices, auxiliary current transformers, monitoring devices, current test switches, terminal connectors, switchboard panel wiring, cable, etc.) shall meet a minimum continuous secondary current rating equivalent to a primary continuous ampere rating of 4,000A and 2-hr emergency ampere rating of 4,400A, unless otherwise specified by CenterPoint Energy. For substations with four or more 138kV transmission lines, the continuous and 2-hr emergency ratings of this equipment may be required to be greater than these values.
- 11.6. The following are minimum requirements for 138 kV bus and transformer protection:
- 11.6.1. Bus protection shall include two independent instantaneous bus differential protective relays (device function 87). A power transformer connected to a bus position will utilize the same two sets of power transformer high-side BCTs (Sub-Article 7.1.2) for both the bus differential protective relays and the power transformer protective relays (Sub-Article 11.6.2). For a Figure 2 substation configuration, instantaneous overcurrent protective relays (device function 50) may be utilized for protection of the bus between the 138 kV circuit breaker and the 138 kV transformer high-side.
- 11.6.2. Each power transformer shall be protected by two protective relays. As a minimum, one of the power transformer protective relays shall be a transformer differential relay (device function 87T), which shall be connected to one of the two sets of power transformer high-side BCTs and the other power transformer protective relay shall have instantaneous and time overcurrent relay (device function 50/51) which shall be connected to a different set of power transformer high-side BCTs than the transformer differential relay. If two multifunction microprocessor current differential protective relays are utilized, CenterPoint Energy does not object to the implementation of both a transformer differential function and a transformer instantaneous/time overcurrent function in each of the two protective relays.
- 11.6.3. The three-line AC schematic drawing(s) showing bus differential protective relay connections and transformer protective relay connections should clearly indicate polarity markings on all current transformers and all protective relay current inputs.
- 11.6.4. Power transformer sudden pressure relay and oil level device(s) should be connected for alarming and tripping. The sudden pressure relay and oil level device(s) should be connected to a different, independent DC branch circuit than the transformer differential relay.
- 11.6.5. If auxiliary relays (device function 94) or lockout relays (device function 86) are used for

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tripping, then two independent relays are required for each tripping zone. The auxiliary relays or lockout relays should be connected to different, independent DC branch circuits.

11.7. All 138 kV circuit breakers connected to a new 138 kV “full loop” substation are required to incorporate local breaker failure relaying. Local breaker failure relaying may be required for each 138 kV circuit breaker at existing substations when deemed necessary by CenterPoint Energy. When practical, the protective relay performing the breaker failure function shall directly trip all appropriate 138 kV circuit breakers (i.e., not utilize an auxiliary relay, a lockout relay or another protection relay to trip the appropriate 138 kV circuit breakers). CenterPoint Energy personnel will calculate set points, apply the settings and test the breaker failure scheme if it is incorporated in transmission line protective relays. If the customer desires to install single function protective relays that are dedicated for breaker failure relaying, then the customer must consult CenterPoint Energy during the development of the relaying and metering one line diagram (described in Sub-Article 14.1.2 of this specification) regarding which relays CenterPoint Energy personnel will calculate set points, apply the settings and test. CenterPoint Energy personnel will calculate set points, apply the settings and test the breaker failure scheme if it is incorporated in single function protective relays that are dedicated for breaker failure relaying but only for the circuit breakers that switch the CenterPoint Energy transmission lines. Testing of the breaker failure scheme in relays set by CenterPoint Energy will occur after the customer has completed the installation and has satisfactorily performed the system operational tests provided in Article 16 of this specification. IT SHALL BE THE CUSTOMER’S RESPONSIBILITY TO INSTALL ALL WIRING AND PEFORM ALL POINT-TO-POINT WIRING CHECKS AND CORRECT ANY WIRING ERRORS.

11.8. The following are specified for connections pertaining to protection and control cables:

- 11.8.1. Connections from one panel to another panel should be made from the terminal blocks on one panel to terminal blocks on the other panel (rather than directly from a device on one panel to a device on a different panel)
- 11.8.2. Protection and control cables should be color-coded and clearly marked to facilitate wire checking and troubleshooting.
- 11.8.3. Current transformer secondary cables shall be grounded only at the relay panels on the non-polarity side of the wye-connected current transformer.

11.9. CenterPoint Energy encourages the use of sequence of events recorders (SERs) and digital fault recorders (DFRs). The application of these systems involves trade-offs between the desire to monitor and record as much information as possible and the need to minimize the number of devices in protective relaying circuits to ensure reliable operation. Any customer planning to install one of these systems is encouraged to discuss their application philosophy with CenterPoint Energy early in the project and to show these devices in the appropriate relaying and SCADA AC and DC schematics when those drawings are submitted for CenterPoint Energy review.

11.10. Customer-owned Intelligent Electronic Devices (IEDs) with settings maintained by CenterPoint Energy (i.e. protective relays associated with CenterPoint Energy transmission network) are not allowed to be monitored directly by the customer. The data from these IEDs can be provided to the customer from a serial port on the CenterPoint Energy SCADA RTU.

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11.10.1. The customer is permitted to connect directly (routable or non-routable communications) to IEDs with settings not maintained by CenterPoint Energy including SCADA electronic meters and microprocessor relays.

11.11. The following are specified for protective relay communication channels:

11.11.1. If the transmission line protective relaying utilized requires power line carrier communication, the power line carrier transmitter/receiver sets shall be located inside the substation control cubicle. The associated power line carrier coaxial cable utilized for making the connection from the substation control cubicle to the line tuner located near the 138 kV coupling capacitor shall be type RG-8/U, 11 AWG, stranded (7/19) bare copper, polyethylene dielectric, 50 ohm nominal impedance, with polyethylene outer jacket. (Note: If an alternate cable is used, an outer jacket with "Excellent" or "Outstanding" water resistance characteristic is required – PVC jacket is not acceptable). The line tuner requires separate mounting at the base of the coupling capacitor stand. A single conductor must be run as directly as possible between this line tuner and the coupling capacitor base housing. The single conductor must be 4 AWG stranded, 5 kV, non- shielded, XLP insulation. The single conductor must be mounted on insulators and fed through bushings at each end. The single conductor insulation should be unbroken between its ends to maintain low leakage. The single conductor must not be directly up against or touching the coupling capacitor support column or other metal components. The insulated single conductor lead-in can be installed in a PVC or other plastic conduit which should be supported on stand- offs or insulators.

11.11.2. When power line carrier communication is utilized, CenterPoint Energy shall determine the frequency for the power line carrier communication. The customer shall procure the power line carrier transmitter/receiver set with an automatic carrier tester according to CenterPoint Energy provided bill of material as indicated in Sub-Article 7.5 and 7.6 of this specification.

11.11.3. If transmission line protective relaying with fiber optics communication is utilized, the customer is required to provide a raceway for the fiber optic cable installation from the transmission line protective relay that requires the fiber optic communication (i.e., relay located in the substation control cubicle) to the base of the first CenterPoint Energy transmission line structure outside the substation. See Sub-Article 5.5.4 of this specification for cases where fiber optic cable comes in overhead. A dedicated raceway (conduit) is required for the fiber optic cable, however a dedicated inner duct installed in a cable trench or a dedicated conduit in a duct bank is acceptable. CenterPoint Energy shall be responsible for supplying, pulling and splicing of the fiber optic cable.

The following guidelines are for the customer provided raceway:

11.11.3.1. Flexible steel conduit 1.50 in. diameter, from the splice box, that is provided and mounted by CenterPoint Energy at the base of the first CenterPoint Energy transmission structure outside of the substation, to the end of the underground conduit provided by the customer.

11.11.3.2. Below grade conduit shall be a minimum 1.50 in. diameter PVC, Schedule 40 with "pull line" (continuous fiber polyolefin, 200 lbs. tensile strength) installed. Conduit shall be at least 18.00 in. below grade, with a protective concrete barrier. The minimum

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bending radius shall be 24.00 in.

- 11.11.3.3. Pull boxes at grade level shall be provided along the cable raceway route at intervals not more than 300 ft. or two 90° bends. A cable pull box in the raceway route is required just inside the substation fence. Pull box shall be 30 in. x 60 in. x 30 in. (Quazite Style No. PG3060BB30 and PG3060HA).
- 11.11.3.4. The customer shall provide 5 in. x 19 in. x 12 in. rack space close to the transmission line protective relaying that utilizes fiber optics communication to accommodate a fiber optic cable distribution box. CenterPoint Energy will provide and install the fiber optic cable distribution box.
- 11.11.3.5. In cases where railroad tracks exist between the substation and the first CenterPoint Energy transmission structure outside of the substation, CenterPoint Energy will give site-specific requirements.
- 11.11.3.6. Customer shall submit drawings and other documents as necessary showing the raceway routing and construction details of the conduit according to Article 14 of this specification.
- 11.11.3.7. Actual designs shall be reviewed by CenterPoint Energy before construction starts.

## **12. REMOTE TELEMETRY**

- 12.1. For remote telemetry requirements (i.e., SCADA), refer to CenterPoint Energy 007-400-02 Specification for Remote Telemetry of a Customer-Owned Facility.

## **13. GENERATION**

- 13.1. Customers desiring to install and/or operate generation rated 1 MW or larger shall follow the Generation Interconnection or Modification Process (<http://www.crcot.com>). Generators shall comply with ERCOT Nodal Operating Guides and Protocols, ERCOT Planning Guides, and CenterPoint Energy engineering specifications and requirements.
- 13.2. CenterPoint Energy will construct new interconnection facilities or expand existing interconnection facilities depending on space and reliability need to serve as the Point of Interconnection Bus (POIB) for the customer as per the signed Standard Generation Interconnection Agreement (SGIA). Substation interconnecting facilities shall be in 'breaker-and-a-half' or 'ring' configuration and will be determined based on reliability need. If generation will be interconnected to existing facilities not entirely owned or operated by CenterPoint Energy, additional engineering and operational criteria will be considered to determine the feasibility.
- 13.3. For customers desiring to install and/or operate generation less than or equal to the customer's load (i.e., 'self-serve'), the requirements for relay and generation/load islanding schemes are as follows:
  - 13.3.1. The customer shall be responsible for installing protective relays to ensure the customer's generators do not sustain a fault on the CenterPoint Energy transmission system. In addition,

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customer generation shall not keep any portion of the CenterPoint Energy transmission system energized in the event that a portion of the CenterPoint Energy transmission system along with the customer's facilities becomes isolated from the rest of the CenterPoint Energy system. The transmission customer shall be responsible for installing protective relays to ensure the customer's generation does not interfere with the automatic reclosing system associated with the CenterPoint Energy transmission system (i.e., The first automatic reclosing attempt on CenterPoint Energy transmission line will occur a minimum of one second after initial trip. See Sub-Article 3.6). CenterPoint Energy will inform the customer of required changes to the automatic reclosing system at other substations associated with the CenterPoint Energy transmission system as a result of the operation of the customer's generators in parallel with the CenterPoint Energy transmission system. CenterPoint Energy will calculate and implement all settings for customer-owned relays installed for the protection and automatic reclosing of CenterPoint Energy transmission lines and for customer-owned 138 kV relays installed to prevent back-energizing a fault on the CenterPoint Energy's system from generation installed on the low-side of customer's power transformers.

- 13.3.2. The customer shall be responsible for installing controls to synchronize the customer's generators with the CenterPoint Energy's system.
- 13.3.3. The customer shall not intentionally impose additional load on the CenterPoint Energy transmission network during an under-frequency disturbance.
- 13.3.4. Customer may island their load and generation from CenterPoint Energy transmission system in one of the following manners (Note: This does not supersede any regulatory frequency ride-through requirements):
  - 13.3.4.1. Customer may island their generation and load from the CenterPoint Energy transmission system if the frequency exceeds 61.8 Hz or goes below 57.5 Hz.
  - 13.3.4.2. Customer may island its generation and a portion of its load from the CenterPoint Energy transmission system at any frequency, provided provisions are installed to ensure that any remaining load imposed on the CenterPoint Energy transmission system is not greater than the load prior to the beginning of the disturbance.
- 13.3.5. Verification of the implementation of the above requirements shall be in accordance with Article 14 of this specification.

#### **14. DRAWING AND DOCUMENTATION COMPLIANCE REVIEW AND COMMENTS**

14.1. The following completed engineering documents shall be submitted in the order shown below for CenterPoint Energy comments, functional review, and compliance with CenterPoint Energy specifications in accordance with Sub-Articles 14.2 through 14.6 of this specification:

- 14.1.1. Site preparation and plot plan drawings shall be submitted to CenterPoint Energy for comment. Facilities that must be shown on this drawing include the dimensions of the substation site, dead- end structure location, access roadways to substation, space around the outside of the substation, (roadways, railroad tracks, walks, pipe racks, etc.), drainage features such as culverts, ditches and detention facilities (if required). Additionally, the elevation of

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18	9/8/2023	Updates to various sections	Var	Var	PM	CHECKED	4/10/74	L. G. Pond
17	9/2/2021	Update sections 4 & 11	Var	Var	GAC	APPROVED	7/17/74	C. S. Kayser
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the substation site should be indicated on these drawings (See Article 6 of this specification).

- 14.1.2. Relaying and metering one-line diagram of high voltage relaying and including generator protection one-line diagram for customers with parallel generation. The diagram shall indicate the maximum current transformer ratio and the current transformer tap ratio being utilized. The diagram shall indicate whether the 138 kV circuit breaker low SF6 gas pressure wiring is set to 'BLOCK TRIP' or to 'AUTO TRIP' the circuit breaker. The diagram shall indicate phase rotation.

CenterPoint Energy shall indicate incoming 138 kV transmission lines designation, power line carrier frequencies (if applicable), location and ratings of metering instrument transformers (high- side or low-side), CenterPoint Energy designations for circuit breakers, switches, power transformers, generators (if applicable) and the CenterPoint Energy assigned long name and 3-character substation identification. CenterPoint Energy will provide a bill of materials as indicated in Sub- Article 11.3 of this specification.

The drawing shall then be revised to show the information provided by CenterPoint Energy and resubmitted to the CenterPoint Energy designated representative. (See Articles 9 and 11 of this specification).

- 14.1.3. Substation plan, profile and section view drawings, including bus and bus supports with material callouts. The plan and profiles must indicate the geographical base lines, center line of dead-end structure and height of static wire and phase wire pull off on the dead-end structure with coordinates and the CenterPoint Energy circuit name and circuit number for incoming 138 kV transmission lines. Material callouts including conductor size, type, and quantity shall be provided in sufficient detail to allow for determination of the continuous and emergency substation facility ratings (See Articles 4 and 5 of this specification).
- 14.1.4. Final/complete relaying and metering one-line diagrams, including generator protection one-line diagram for customers with parallel generation.
- 14.1.5. When the interconnection agreement indicates that the customer must install equipment (i.e., motor soft start, variable frequency drive (VFD), etc.) in order to satisfy the CenterPoint Energy interconnection requirements of Sub-Article 4.88 of this specification, drawings and documentation of equipment to be installed shall be submitted for CenterPoint Energy review.
- 14.1.6. Equipment specification for all major pieces of equipment such as power transformers, 138 kV circuit breakers, surge arresters, disconnect switches, coupling capacitors and line traps. (See Articles 4 and 7 of this specification).
- 14.1.7. The foundation location plan. (See Articles 5 and 6 of this specification).
- 14.1.8. Design calculations, drawings and associated documents for the substation dead-end structures, instrument transformer stands, and foundations. These documents shall be submitted 30 days prior to the scheduled fabrication start.
- 14.1.9. AC and DC schematics of high voltage relaying, control and SCADA schemes. AC and DC panel board drawings. These drawings shall be submitted after the documents required in Sub- Article 14.1.2 of this specification have been approved.

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- 14.1.10. Where low-side metering is used, as determined by CenterPoint Energy, original certified test data in PDF electronic file shall be provided to CenterPoint Energy for each metering instrument transformer installed (See Sub-Articles 9.2.1.2 of this specification).
- 14.1.11. The power transformer AC schematic, breaker schematics and BCT curves.
- 14.1.12. Power transformer and 138 kV circuit breaker nameplate drawings, line trap instruction book and drawings and line tuner instruction book and drawings.
- 14.1.13. Relaying, control and SCADA bill of materials. These documents shall be submitted after the documents required in Sub-Article 14.1.4 of this specification have been approved.
- 14.1.14. Cable and conduit list and routing layout.
- 14.1.15. Front and Back View of high voltage relay and control panels including interconnections.
- 14.1.16. Substation control cubicle layout drawing. (See Article 8 of this specification).
- 14.1.17. Detail (point-to-point) wiring diagrams shall be submitted, not for approval, but for use in accordance with Article 11 of this specification.
- 14.1.18. The customer calculated relay settings for the 138 kV bus and 138 kV transformer protective relay schemes and 138 kV circuit breaker failure relaying.
- 14.2. A PDF electronic file of each of the drawings indicated in Sub-Article 14.1 of this specification shall be sent, for review/comments, to the CenterPoint Energy designated representative unless a different format is specifically requested by CenterPoint Energy. Certain types of engineering documents depend upon finalization of other documents. For example, relay panel drawings cannot be prepared until the relaying AC and DC schematics are finalized. Therefore, engineering documents shall be submitted for CenterPoint Energy comments or approval in the proper sequence.
- 14.3. Customer drawings should be 100% complete when given to CenterPoint Energy to review. If a functional review cannot be done, CenterPoint Energy shall comment on compliance with CenterPoint Energy specifications and return to customer. The drawings shall then be resubmitted with CenterPoint Energy comments incorporated when 100% complete. The customer shall then proceed with drawing submittal in accordance with Sub-Article 14.4 of this specification.
- 14.4. Customer drawings that are 100% complete and marked "For Approval" shall be functionally reviewed by CenterPoint Energy for compliance with CenterPoint Energy specifications. If additional comments are made by CenterPoint Energy on the 100% complete drawings, the customer may:
  - 14.4.1. Incorporate the CenterPoint Energy comments and resubmit these drawings for further review of compliance with CenterPoint Energy specifications, or
  - 14.4.2. Notify the CenterPoint Energy designated representative acknowledging that CenterPoint Energy comments were received and shall be incorporated into the "For Construction" drawings.

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- 14.5. Should the customer disagree with comments by CenterPoint Energy, the customer shall notify the CenterPoint Energy designated representative explaining why revisions are not necessary.
- 14.6. Once all issues are resolved, the final set of drawings shall be marked "For Construction." After, the substation is energized a PDF electronic file of each of the drawings indicated in Sub-Article 14.1 of this specification, "As Built" drawings of the substation shall be sent to the CenterPoint Energy designated representative within 90 days.

## 15. EQUIPMENT INSTALLATION

- 15.1. The protective enclosure around the substation including gates and grounding shall be installed in accordance with the National Electrical Safety Code (IEEE C2), IEEE 1119 and IEEE 80.
- 15.2. CenterPoint Energy shall assign a long name and a 3-character substation identification to the customer-owned substation. CenterPoint Energy shall post the long name and 3-character substation identification on the door of the substation control cubicle and on the entrance gate of the substation. The long name and/or the 3-character substation identification shall be used to identify the customer-owned substation for any communications or correspondence. The 3-character mnemonic shall be used to identify the facility in the ERCOT Operations model.
- 15.3. The customer shall install all substation equipment and make all connections, except as otherwise noted in this specification. The customer shall make all equipment installation checks required by Article 16 of this specification and shall make all required measurements and readings available to CenterPoint Energy personnel if requested.
- 15.4. CenterPoint Energy will verify that the 138 kV switches operate correctly.
- 15.5. CenterPoint Energy will have the sole responsibility for calculating relay set points, applying relay settings and "out of case" testing of the following relays:
- 15.5.1. Transmission line relaying and tuning components of the associated power line carrier equipment communication channel,
- 15.5.2. Relays for 138 kV transmission line automatic reclosing, and
- 15.5.3. Relays for 138 kV breaker failure protection when specified by CenterPoint Energy.

Note: The appropriate operation of protective relays and control circuits by performing trip and close testing from devices of Sub-Articles 15.5.1 through 15.5.3 of this specification above shall be conducted with CenterPoint Energy present to direct and observe test (24 hr. advance notice required).

- 15.6. CenterPoint Energy will furnish locks which shall remain in series with customer locks for all 138 kV disconnect switches, substation control cubicle doors and gates(s) to and from the substation.
- 15.7. The 138 kV circuit breakers, air switches and power transformers will be assigned numbers in accordance with CenterPoint Energy dispatching numbers. The numbers are to be shown on the one-line diagram and shall be marked on the circuit breaker tanks, switch handles and power transformers.

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- 15.8. CenterPoint Energy will coordinate and provide the procedures for energizing the customer-owned substation 138 kV equipment.

## 16. **REQUIRED TESTS AND INSPECTIONS**

- 16.1. During installation but prior to energizing the equipment, the customer shall perform the following tests and inspections. CenterPoint Energy will observe the tests below that are marked with an asterisk (\*).

- 16.1.1. Diagnostic testing (e.g., insulation power factor (“Doble testing”, etc.), insulation resistance (“Megger”, etc.) of all equipment (e.g., arresters, coupling capacitors, etc.), including all tests as specified by manufacturer.

- 16.1.2. The required tests and inspections for control cables and panels are as follows:

- 16.1.2.1. Check continuity and perform insulation resistance test conductor-to-ground and conductor-to-conductor.
- 16.1.2.2. Perform a point-to-point wiring check of protective relaying and control panels.
- 16.1.2.3. Verify protective relaying control circuits by performing functional trip and close testing.\*
- 16.1.2.4. Inject current from current transformers through relays.\*
- 16.1.2.5. CenterPoint Energy personnel will calculate the set points, apply the settings and test the multi-function transmission line protection relays after the customer has completed point- to-point wiring checks of protective relaying and control panels and verified protective relaying control circuits by performing functional trip and close testing.

- 16.1.3. The required tests and inspections for power cables are as follows:

- 16.1.3.1. Check continuity and phasing sequence.
- 16.1.3.2. Perform insulation resistance test of cables.
- 16.1.3.3. High-pot.

- 16.1.4. The required tests and inspections for circuit breakers are as follows:

- 16.1.4.1. Inspect and adjust main auxiliary switch assembly per manufacturer’s instructions.
- 16.1.4.2. Inspect, adjust, and lubricate operating mechanism per manufacturer’s instructions.
- 16.1.4.3. Ratio check, excitation test, insulation resistance test, and polarity on all current transformers. Leave un-used current transformers shorted and grounded on secondary terminals.

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- 16.1.4.4. Check resistance of close, trip and trip free coils.
- 16.1.4.5. Perform insulation resistance test of main contact assembly and bushings. Measure main contact resistance ("Ductor").
- 16.1.4.6. Make dielectric insulation and power factor tests on main contact assembly and bushings.
- 16.1.4.7. Perform insulation resistance test of control circuits conductor-to-ground and conductor-to-conductor.
- 16.1.4.8. Record all measurements and readings.
- 16.1.4.9. Make time-travel recordings to verify proper opening speed.
- 16.1.5. The required tests and inspections for disconnects and switches are as follows:
  - 16.1.5.1. Check and adjust contact alignment and wipe. \*
  - 16.1.5.2. Adjust operating linkage to obtain full open and close positions and tighten all clamps and set screws. \*
  - 16.1.5.3. Check and tighten all electrical connections.
  - 16.1.5.4. Lubricate linkage and bearings, if required.
  - 16.1.5.5. Clean all grease from contacts.
- 16.1.6. The required tests and inspections for batteries and charger are as follows:
  - 16.1.6.1. Assemble batteries per manufacturer's instructions.
  - 16.1.6.2. Coat all connections on battery terminals with no-oxide grease.
  - 16.1.6.3. Install, connect, and adjust charger per manufacturer's instructions.
  - 16.1.6.4. Put batteries on equalize charge until the specific gravity of all cells is within the limits set by manufacturer.
  - 16.1.6.5. Read and record the float voltage and specific gravity of each cell.

## 17. **RECOMMENDED TESTS AND INSPECTIONS**

- 17.1. During installation but prior to energizing the equipment, CenterPoint Energy recommends that the customer perform the following tests and inspections, as a minimum. This list is not considered to be exhaustive or all-inclusive.

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- 17.1.1. For low-side equipment, test relays, check transformer and bus automatic reclosing and check operations indicators when tripping through the panel with current.

Note: CenterPoint Energy will calculate and implement all settings for customer-owned relays installed for the protection and automatic reclosing of CNP transmission lines and for customer-owned 138 kV relays installed to prevent back-energizing CNP's system from generation installed on the low-side of customer power transformers. On a case-by-case basis, CNP may issue settings for other customer-owned relays.

- 17.1.2. The recommended tests and inspections for all substation equipment are as follows:

- 17.1.2.1. Clean rusted surfaces, prime all bare metal surfaces, and touch up with paint matching the finish coat.

- 17.1.3. The recommended tests and inspections for control work are as follows:

- 17.1.3.1. Wire check all cables to current transformers and perform insulation resistance test of cables.

- 17.1.3.2. In the following order:

- 17.1.3.2.1. Polarity check current transformers.

- 17.1.3.2.2. Ratio check current transformers.

- 17.1.3.2.3. Excitation test current transformers.

- 17.1.3.2.4. Insulation resistance test current transformers.

- 17.1.3.3. Check cable connections to panels.

- 17.1.3.4. Wires check panels.

- 17.1.4. The recommended tests and inspections for switchgear are as follows:

- 17.1.4.1. Check all bolted bus connections.

- 17.1.4.2. High-pot cable with 25 kV DC.

- 17.1.4.3. Ensure that all exposed bus work is properly insulated.

- 17.1.4.4. Bridge all bus work.

- 17.1.4.5. Perform dielectric insulation and power factor tests on all bus work.

- 17.1.4.6. Check breaker-lifting devices for alignment and adjust limit switches, if necessary.

- 17.1.4.7. Adjust auxiliary and cell switches.

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17.1.4.8. Check continuity for all AC, DC control, and current transformer circuits.

17.1.5. The recommended tests and inspections for transformers are as follows:

17.1.5.1. Visually inspect for internal shipping damage and check all internal connections.

17.1.5.2. Install bushing and accessories per manufacturer's instructions.

17.1.5.3. Inspect load tap changer (LTC) compartment and adjust per manufacturer's instruction and check LTC operation, if applicable.

17.1.5.4. Bridge primary and secondary windings on all tap positions and a final check on the tap position that will be used.

17.1.5.5. Ratio check, excitation test, perform insulation resistance test, and check polarity on all current transformers. Leave unused current transformers shorted and grounded on the secondary.

17.1.5.6. Vacuum fill per manufacturer's instructions.

17.1.5.7. Check for oil and gas leaks. (This may be done prior to vacuum filling).

17.1.5.8. Test oil before and after filling. (Maximum power factor, minimum dielectric strength, color, acidity, and interfacial tension).

17.1.5.9. Test oil for dissolved combustible gas and moisture content (Note: This test is to be performed 24 to 48 hours after the substation has been energized).

17.1.5.10. Check voltage regulating relay and controls.

17.1.5.11. Check cooling equipment and controls.

17.1.5.12. Check nitrogen-regulating equipment and adjust per manufacturer's instructions.

17.1.5.13. Check sudden pressure relay and associated circuits.

17.1.5.14. Check and connect desired alarm circuits.

17.1.5.15. Perform insulation resistance test and insulation power factor test of bushing and windings (e.g., "Doble testing").

17.1.5.16. Check all bushings to bus connections.

17.1.5.17. Check all current transformers and control circuit connections.

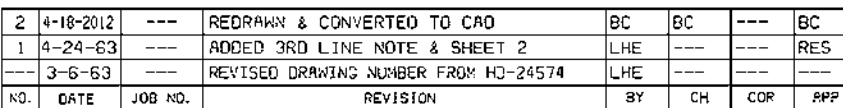
17.1.5.18. Record all measurements and readings.

17.1.5.19. Check core ground.

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**NOTES:**

1. DRAWING INDICATES TERMINATION OF CENTERPOINT ENERGY LINE & SERVICE TO CUSTOMER SUBSTATION.
2. THIS DRAWING NOT INTENDED TO SHOW THE LOCATION OR TYPE OF CUSTOMER EQUIPMENT.
3. NUMBER & TYPE OF INSULATORS TO BE DETERMINED BY STATION VOLTAGE.



CUSTOMER OWNED SUBSTATION			
LINE TERMINATION STANDARD			
CENTERPOINT ENERGY, INC.			
HOUSTON, TEXAS			
DRAWN 4-18-2012	B. CHATMAN		SCALE NTS
CHECKED			SHEET 1 OF 2 SHEETS
CORRECT			DRAWING NUMBER
APPROVED 4-18-2012	D. SEVCIK		004 241 04

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20	10/17/2024	Added 345kV Specification	Var	Var	JPT3	
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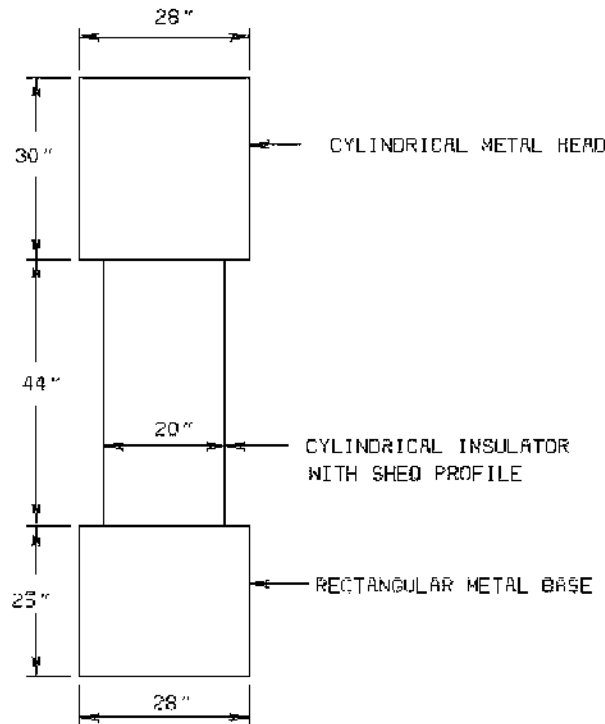
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THIS DIAGRAM REPRESENTS THE MAXIMUM DIMENSIONS, AND MAXIMUM WEIGHT OF POSSIBLE 138 KV CT'S OR PT'S THAT CENTERPOINT ENERGY WILL PROVIDE FOR THE 138 KV BILLING METER.

THIS DIAGRAM PROVIDES THE NECESSARY STRUCTURAL AND MECHANICAL DESIGN PARAMETERS TO BE USED FOR THE INSTRUMENT TRANSFORMER FOUNDATIONS AND STANDS THAT WILL SUPPORT 138 KV CT'S OR PT'S THAT CENTERPOINT ENERGY WILL PROVIDE.

THIS DIAGRAM MUST ALSO BE USED, IN CONJUNCTION WITH SUBSTATION BUS PROFILE DIMENSIONS, TO DETERMINE THE HEIGHT OF THE STANDS THAT WILL SUPPORT THE INSTRUMENT TRANSFORMERS THAT CNP WOULD PROVIDE FOR THE 138 KV BILLING METERING.

AFTER THE INSTRUMENT TRANSFORMER STAND HEIGHT HAS BEEN DETERMINED BASED ON THE ABOVE INFORMATION, THE MANUFACTURER'S OUTLINE DRAWING FOR THE ACTUAL 138 KV CT'S AND PT'S THAT CENTERPOINT ENERGY WILL PROVIDE MUST BE USED TO DETERMINE THE DETAILS OF THE PRIMARY CONNECTION(S) AND SECONDARY TERMINAL BOX CONDUIT CONNECTION.

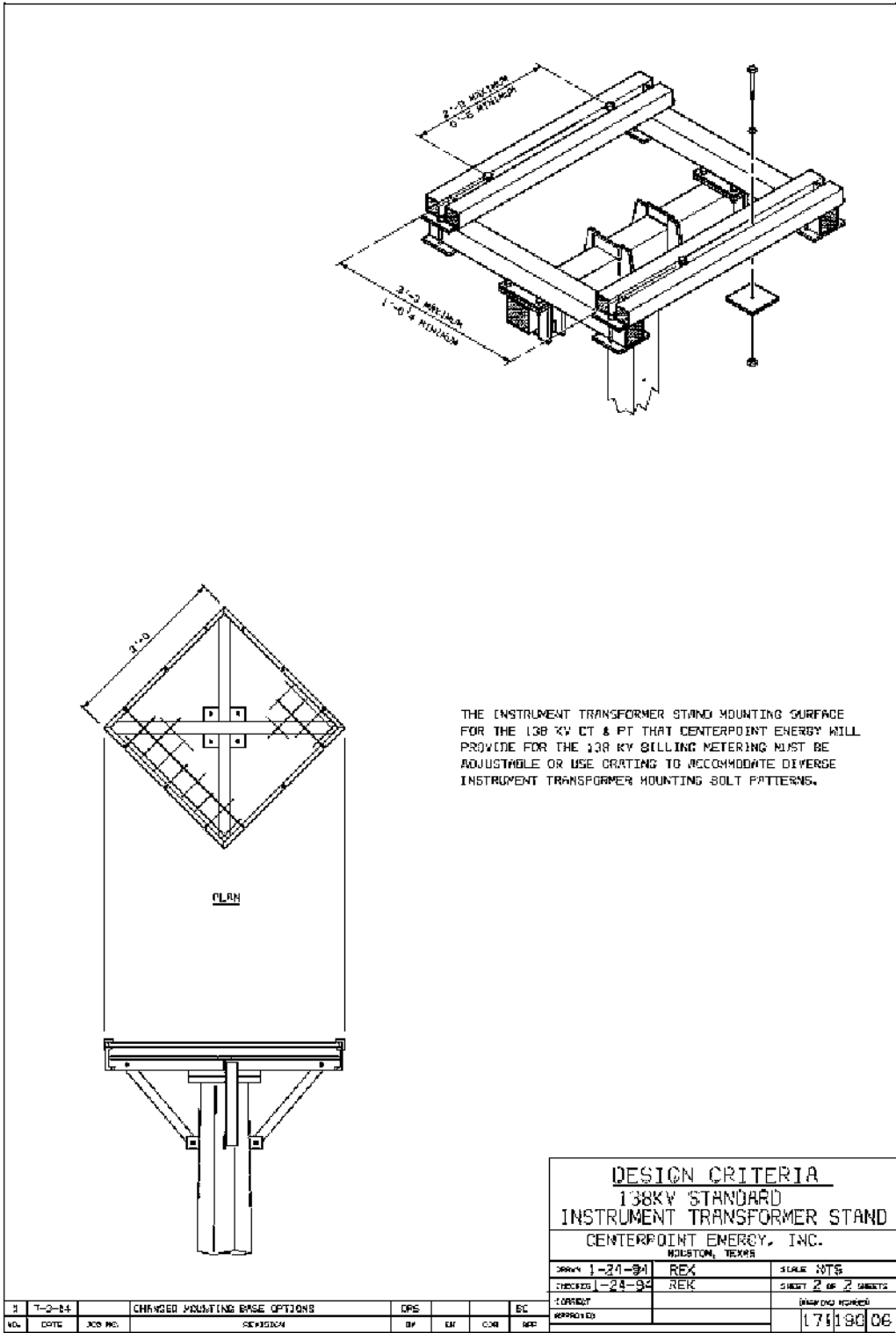


WEIGHT = 1500 LBS

DESIGN CRITERIA			
138KV STANDARD INSTRUMENT TRANSFORMER STAND			
CENTERPOINT ENERGY, INC.			
HOUSTON, TEXAS			
CADWON 1-24-84	REK	SCALE	MTS
CHECKED 1-24-84	REK	SHEET 1 OF 2 SHEETS	
DESIGNED		DRAWING NUMBER	
APPROVED		17:19006	

NO.	DATE	DESCRIPTION	DRS	BY	CH	APP	EC
1	7-3-14	CHANGED DESIGN PARAMETERS	DRS				EC

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